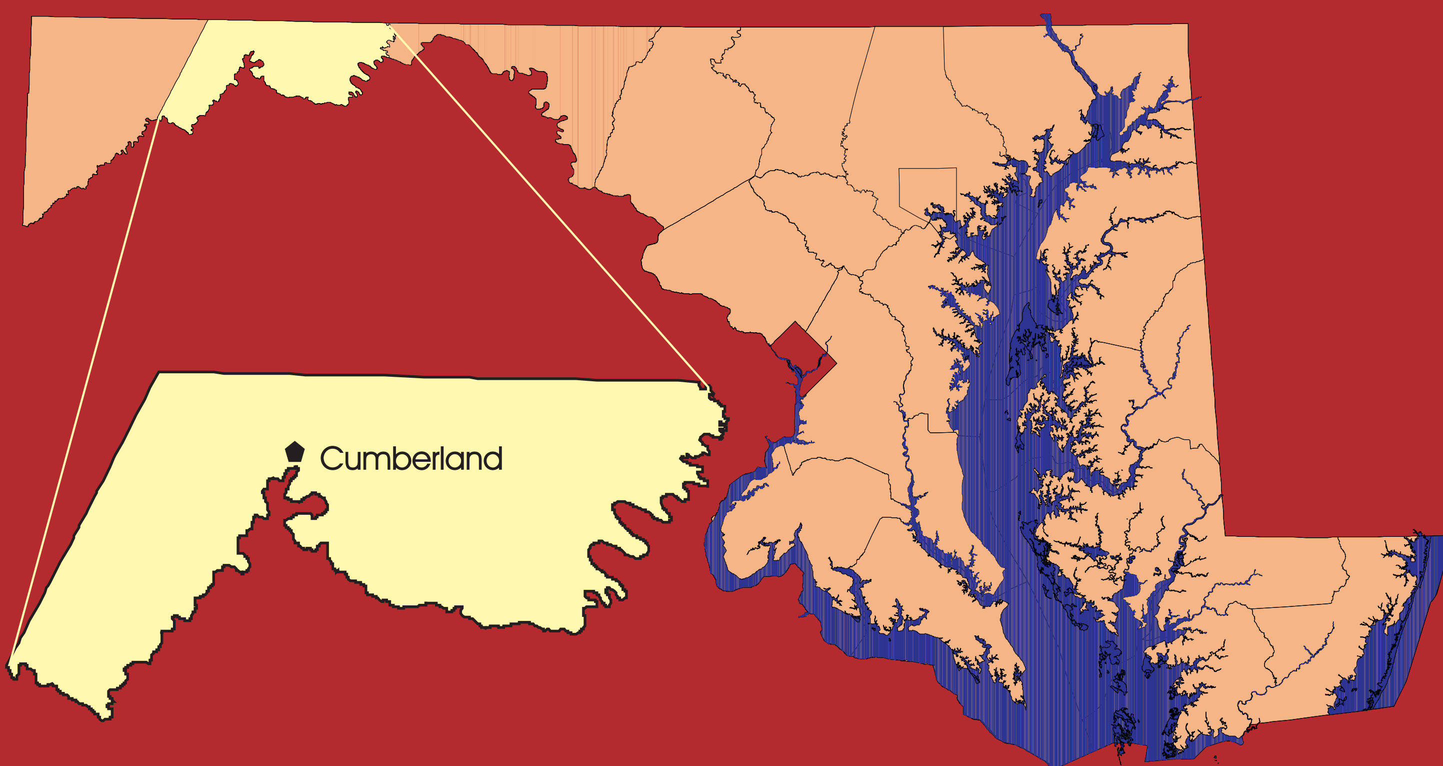
ALLEGANY COUNTY

RESULTS OF THE 1994-1997 MARYLAND BIOLOGICAL STREAM SURVEY: COUNTY ASSESSMENTS



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ALLEGANY COUNTY

Results of the 1994-1997 Maryland Biological Stream Survey: County-Level Assessments

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December 2001

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FOREWORD

This report is based on results of the Maryland Biological Stream Survey (MBSS), a program funded primarily by the Power Plant Research Program and administered by the Maryland Department of Natural Resources (MDNR). Field data for the MBSS were collected by the Maryland Department of Natural Resources. Analyses of water chemistry samples were conducted by the University of Maryland's Appalachian Laboratory. Much of the initial data analysis was conducted by Versar, Inc. for MDNR's Power Plant Assessment Division.

This report helps fulfill two outcomes in MDNR's Strategic Plan: 1) A Vital and Life Sustaining Chesapeake Bay and Its Tributaries, and 2) Sustainable Populations of Living Resources and Healthy Ecosystems.

ACKNOWLEDGMENTS

The 1994-1997 Maryland Biological Stream Survey has been a cooperative effort among several agencies, consultants and academic institutions. We wish to thank Nancy Roth and Ginny Mercurio from Versar in helping to compile some of the data used in this report. Versar also designed the sampling program, obtained landowners' permissions, and helped manage the data. We are also grateful to the many individuals from Maryland Department of Natural Resources, the University of Maryland's Appalachian Laboratory (AL), and the University of Maryland's Wye Research and Education Center (WREC) who comprised the field crews and did a great job collecting the data. MDNR staff also digitized watersheds and calculated land use data, provided quality assurance, and conducted field crew training. Nancy Roth and her colleagues at Versar developed the fish Index of Biotic Integrity, and Dr. Sam Stribling and his staff at Tetra Tech, Inc. developed the benthic Index of Biotic Integrity. Dr. Ray Morgan of AL and Mr. Lenwood Hall of the WREC supervised additional field crews and developed the Physical Habitat Index, and Dr. Keith Eshleman of AL assisted with analyses of data on acidified streams. Drs. Wayne Starnes and Bob Reynolds of the Smithsonian Institution (reptiles and amphibians), Dr. Rich Raesly of Frostburg State University (fish), Rita Villella of the U.S. Geological Survey Leetown Science Center (mussels), and Michael Naylor of MDNR (aquatic vegetation) provided taxonomic verifications of voucher specimens. The success of the project resulted from the strong efforts of all these groups. Special thanks go to Ron Klauda for his editorial support and Brenda Morgan for her assistance in formatting, editing, and organizing the report.

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INTRODUCTION

This report presents county-level data from the 1994-1997 Maryland Biological Stream Survey (MBSS or the Survey). Previous reports have documented interim results from the 1995 (Roth et al. 1997) and 1996 (Roth et al. 1998a) sample years. In addition, a comprehensive final report was produced to assess the "state of the streams" throughout the state (Roth et al. 1999). All previous MBSS reports have presented information by individual drainage basins. Because there is a recognized need for stream health information at the county level, a series of reports were prepared; this report is part of that series. This introductory section recounts the origin of the Survey and describes its components.

Origin of the MBSS

More than 10 years ago, the Maryland Department of Natural Resources (MDNR) recognized that atmospheric deposition was one of the most important environmental problems resulting from the generation of electric power. To determine the extent of acidification of Maryland streams resulting from acidic deposition, MDNR conducted the Maryland Synoptic Stream Chemistry Survey (MSSCS) in 1987. The MSSCS estimated the number and extent of streams at that time affected by or sensitive to acidification statewide and demonstrated the potential for adverse effects on biota from acidification. However, little direct information was available on the biological responses of Maryland streams to water chemistry conditions. Data that were available could not be used (because of methodological differences and spatial coverage limitations) to compare conditions across regions or watersheds (Tornatore et al. 1992). Neither was it possible to assess the interactions between acidic deposition and other anthropogenic and natural influences (CBRM 1989). For these reasons, in 1993, MDNR created the MBSS to provide comprehensive information on the status of biological resources in Maryland streams and how they are affected by acidic deposition and other cumulative effects of anthropogenic stresses.

Description of the MBSS

The MBSS is intended to help environmental decision-makers protect and restore the natural resources of Maryland. The primary objectives of the MBSS are:

- to assess the current status of biological resources in Maryland's non-tidal streams;
- to quantify the extent to which acidic deposition has affected or may be affecting biological resources in the state;
- to examine which other water chemistry, physical habitat, and land use factors are important in explaining the current status of biological resources in streams;
- to compile the first statewide inventory of stream biota;
- to establish a benchmark for long-term monitoring of trends in these biological resources; and
- to target future local-scale assessments and mitigation measures needed to restore degraded biological resources.

In creating the Survey, MDNR implemented a probability-based sampling design as a cost-effective way to characterize statewide stream resources. By randomly selecting sites, the Survey can make quantitative inferences about the characteristics of all 9,258 miles of first-to-third-order, non-tidal streams in Maryland (based on stream length on a 1:250,000-scale base map). MDNR recognized that the utility of these estimates depended on accurately measuring appropriate attributes of streams. The Survey focuses on biology for two reasons: (1) organisms themselves have direct societal value and (2) biological communities integrate stresses over time and are a valuable and cost-effective means of assessing ecological integrity (i.e., the capacity of a resource to sustain its inherent potential).

Fish are an important component of stream integrity and one that also contributes to substantial recreational values. For these reasons, fish communities are a primary focus of the Survey. The Survey collects quantitative data for the calculation of population estimates for individual fish species (both game and nongame). These data can also be used to evaluate fish community composition, individual fish health, and the geographic distribution of commercially important, rare, or non-indigenous fish species. Benthic (bottom-dwelling) macroinvertebrates are another essential component of streams and they constitute the second principal focus of the Survey. The Survey uses rapid bioassessment procedures for collecting benthic macroinvertebrates; these semi-quantitative methods permit comparisons of relative abundance and community composition, and have proven to be an effective way of assessing biological integrity in streams (Hilsenhoff 1987, Lenat 1988, Plafkin et al. 1989, Kerans and Karr 1994, Resh 1995). The Survey also records the presence of reptiles and amphibians (herpetofauna), freshwater mussels, and aquatic plants (both submerged aquatic vegetation (SAV) and emergent macrophytes). The Survey has established rigorous protocols (Kazyak 1996) for each of these sampling components, as well as training and auditing procedures to assure that data quality objectives are met.

Although the MBSS sampling design and protocols provide exceptional information for characterizing the stream resources in Maryland, designation of degraded areas and identification of likely stresses requires additional activities. Assessing the condition of biological resources (whether they are degraded or not degraded) requires the development of ecological indicators that permit the comparison of sampled segment results to minimally impacted reference conditions (i.e., the biological community expected in watersheds with little or no human-induced impacts). The Survey has used its growing database of information collected with consistent methods and broad coverage across the state to develop and test indicators of individual biological components (Stribling et al. 1998, Roth et al. 1998b) and physical habitat quality (Hall et al. 1999). Each of these indicators consists of multiple metrics using the general approach developed for the Index of Biotic Integrity (IBI) (Karr et al. 1986, Karr 1991) and the Chesapeake Bay Benthic Restoration Goals (Ranasinghe et al. 1994). The fish and benthic macroinvertebrate IBIs (which combine attributes of both the number and the type of species found) are widely accepted indicators that have been adapted for use in a variety of geographic locations (Miller et al. 1988, Cairns and Pratt 1993, Simon 1999). The Survey is investigating the possibility of developing additional indicators (e.g., amphibians in small streams with few or no fish) and combining components into a composite indicator of biological integrity.

In addition to developing reference-based indicators, the Survey is applying a variety of analytical methods to the question of which stressors are most closely associated with degraded streams. This involves correlational and multivariate analyses of water chemistry, physical habitat, land use, and biological information (e.g., presence of non-native species). The biological information also provides a valuable opportunity for documenting aquatic biodiversity across the state; the distribution and abundance of species previously designated as rare only by anecdotal evidence can be determined, and unique combinations of species at the ecosystem and landscape levels can be identified. Land use and other landscape-scale metrics will play an important role in identifying the relative contributions of different stressors to the cumulative impact on stream resources. Ultimately, the Survey seeks to provide an integrated assessment of the problems facing Maryland streams that will facilitate interdisciplinary solutions for their restoration. The survey also provides resource managers with the locations of relatively undisturbed streams and watersheds that deserve protection.

METHODS

This section presents the specific study design and procedures used to implement the Maryland Biological Stream Survey. The study area of concern and the sampling design developed to characterize it are presented, along with field and laboratory methods for each component: fish, benthic macroinvertebrates, reptiles and amphibians, physical habitat, and water chemistry. Methods for aquatic vegetation and mussel sampling are presented, but the resulting data are not included in this report. A full description of MBSS methods can be found in Kazyak (1996).

MBSS Study Design

The Survey study area comprises 17 distinct drainage basins across the state. Random sampling was used to allow the estimation of unbiased summary statistics (e.g., means, proportions, and their respective variances) for the entire state, a particular basin, and subpopulations of interest (e.g., streams with pH < 5).

Because it would have been cost prohibitive to visit a sufficient number of sites in all basins in a single year, lattice sampling was used to schedule sampling of all basins over a three-year period, 1995-1997. Lattice sampling, also known as multistratification, is a cost-effective means of allocating effort across time in a large geographic area (Heimbuch 1999, Jessen 1978, Cochran 1977). A table, or lattice, was formed by arranging 17 basins in 17 rows, and the years in 3 columns. Lattice sampling was the method used for selecting cells from this 17x3 table so that all basins would be sampled over a three-year period and all basins would have a non-zero probability of being sampled in a given year. The data presented in this report include those collected at random sampling sites within the 17 principal basins in Maryland, as well as sites from the 1994 demonstration project. Because no estimates were calculated for this report, these data were included to supplement the number of sites.

The sampling frame for the Survey was constructed by overlaying basin boundaries on a map of all blue-line stream reaches in the study area as digitized on a U.S. Geological Survey 1:250,000 scale topographic map. This sample frame was similar to that used by the earlier Maryland Synoptic Stream Chemistry Survey (MSSCS) conducted in 1987 (Knapp and Saunders 1987, Knapp et al. 1988). The Strahler convention (Strahler 1957) was used for ranking stream reaches by order; first-order reaches, for example, are the most upstream reaches in the branching stream system. Sampling was restricted to non-tidal, third-order and smaller stream reaches, excluding impoundments that were non-wadable or that substantially altered the riverine nature of the reach (Kazyak 1994). Together, these first-through third-order streams comprise about 90% of all stream and river miles in Maryland. Stream reaches were further divided into non-overlapping, 75-meter segments; these segments were the elementary sampling units from which biological, water chemistry, and physical habitat data were collected.

The 1995-1997 MBSS study design was based on stratified random sampling of segments within each basin; each basin was stratified by stream order. Within a stream order, the number of segments sampled per basin is proportional to the number of stream miles in the basin. To achieve the target number of samples per stream order within each basin, a given number of segments were randomly selected from each basin and ranked in order of selection. In all basins, extra segments were selected as a contingency against loss of sampling sites from restricted access to selected streams or from streams that were dry, too deep, or otherwise unsampleable owing to field conditions. In some basins, where only a small number of sites would have been selected using this method, additional random sites were selected to increase sample size. These extra sites (selected at random using the method described above) were used to provide better basinwide estimates; they were not included in the estimates of statewide conditions.

Permissions were obtained to access privately owned land adjacent to or near each stream segment. The procedures for obtaining permissions are described in Chaillou (1995). Because landowner permissions were obtained in a synoptic fashion and some variation in these rates occurred, we obtained more permissions than were needed for the Survey. Only the highest ranking sites were sampled until the target goal for that basin was reached. For the three year study, the success rate for obtaining permission to access stream sampling segments was high. Eighty-eight percent of sites that were targeted for permission were sampled.

Reasons for permission denial varied and generally reflected the preferences of landowners regarding property access, rather than any specific types of land. In rare cases, permission denial may affect the interpretation of Survey estimates, but only where denials occur in streams with characteristics that differ from the general population of streams. In one example of potential bias, several sites with known coal mining activities in the North Branch Potomac basin denied permission to sample, likely under representing the proportion of acid mine drainage streams in the population.

Field and Laboratory Methods

Benthic macroinvertebrate and water quality sampling were conducted in spring, when the benthos are thought to be reliable indicators of environmental stress (Plafkin et al. 1989) and when acid deposition effects are often the most pronounced. Fish, reptiles and amphibians, aquatic vegetation, and mussel sampling, along with physical habitat evaluations, were conducted during the low-flow period in summer. Fish community composition tends to be stable during summer, and low flow is advantageous for electrofishing. Because low-flow conditions in summer may be a primary factor limiting the abundance and distribution of fish populations, habitat assessments were performed during the summer. The sample size in summer is lower than in spring because some streams were dry in summer or were, in rare cases, otherwise unsampleable.

To reduce temporal variability, sampling during spring and summer was conducted within specific, relatively narrow time intervals, referred to as index periods (Janicki et al. 1993). These index periods were defined by degree-day limits for specific parts of the state. This approach provided a synoptic assessment of the current status of stream biota, water quality, and physical habitat in the 17 basins sampled. The spring index period was the time period between approximately March 1 and May 1, with end of the index period determined by degree-day accumulation as specified in Hilsenhoff (1987). In reality, most spring samples (78%) were collected in March, well before degree-day accumulation limits were approached. The summer index period was between June 1 and September 30 (Kazyak 1994).

Data Collection and Measurement

Field sampling followed procedures specified in the MBSS sampling manual (e.g., Kazyak 1996). A summary of the variables measured and the field and laboratory methods used to conduct the sampling follows.

Fish

Fish were sampled during the summer index period using double-pass electrofishing within 75-meter stream segments. Block nets were placed at each end of the segment and direct current backpack electrofishing units were used to sample the entire segment. An attempt was made to thoroughly fish each segment, and consistent effort was applied over the two passes. This sampling approach allowed calculation of several metrics useful in calculating a biological index and produced unbiased estimates of fish species abundance.

In small streams, a single electrofishing unit was used. In larger streams, two to five units were employed to effectively sample the site. Captured fish were identified to species, counted, weighed, and released. Any individuals that could not be identified to species were retained for laboratory confirmation. For each pass, all individuals of each gamefish species (defined as trout, bass, walleye, pike, chain pickerel, and striped bass) were measured for total length and examined for visible external pathologies or anomalies. For nongame species, up to 100 fish of each species (from both passes) were examined for visible external pathologies or anomalies. For each pass, all non-game species were weighed together for an aggregate biomass measurement; gamefish were also weighed in aggregate to the nearest 10 g.

Electrofishing was also conducted at supplemental, non-randomly selected sites during the summer index period. The presence of each species of fish was recorded for these segments to provide additional qualitative information on statewide fish distributions. Sampling effort at most qualitative sites was based on doubling the elapsed time since the last species was recorded or a minimum of 600 seconds of electrofishing effort.

After processing the fish collected in the field, voucher specimens were retained for each species not previously collected in the drainage basin. In addition, all individuals which could not be positively identified in the field were retained. The remaining fish were released. All voucher specimens and fish retained for positive identification in the laboratory were examined and verified by the MBSS Quality Assurance Officer or ichthyologists at Frostburg State University, Frostburg, Maryland or the Smithsonian Institution, Washington, DC.

Benthic Macroinvertebrates

Benthic macroinvertebrates were collected to provide a qualitative description of the community composition at each sampling site (Kazyak 1996). Sampling was conducted during the spring index period. Benthic community data were collected for the purpose of calculating biological metrics, such as those described in EPA's Rapid Bioassessment Protocols (Plafkin et al. 1989), and use as an indicator of biological integrity for Maryland streams.

At each segment, a 600 micron mesh "D" net was used to collect organisms from habitats likely to support the greatest taxonomic diversity. A riffle area was preferred, but other habitats were also sampled using a variety of techniques including kicking, jabbing, and gently rubbing hard surfaces by hand to dislodge organisms. If available, other habitat types were sampled, including rootwads, woody debris, leaf packs, macrophytes, and undercut banks. Each jab covered one square foot, and a total of approximately 2.0 m^2 (20 square feet) of combined substrates was sampled and preserved in 70% ethanol. In the laboratory, the preserved sample was transferred to a gridded pan and organisms were picked from randomly selected grid cells until the cell that contained the 100th individual (if possible) was completely picked. Some samples had fewer than 100 individuals. The benthic macroinvertebrates were identified to genus, or lowest practicable taxon, in the laboratory.

Index of Biotic Integrity

Sites were evaluated using both the fish (F-IBI) and benthic macroinvertebrate (B-IBI) IBIs developed for the MBSS (for detailed methods, see Roth et al. 1997 and Stribling et al. 1998). IBI scores for the MBSS are determined by comparing the fish or benthic macroinvertebrate assemblages at each site to those found at minimally impacted reference sites. Three separate formulations were employed for the fish IBI, one for each of three distinct geographic areas: Coastal Plain, Eastern Piedmont, and Highland. The two formulations used for the benthic IBI cover the Coastal Plain and non-Coastal Plain regions. Individual metrics for the IBI are scored 1, 3, or 5, based on comparison with the distribution of metric values at reference sites. For either the individual metrics or total IBI, a score of 3 or greater is considered comparable to reference site conditions, while scores falling below this threshold differ significantly from the reference conditions. Scores for the MBSS IBIs are calculated as the mean of the individual metric scores and therefore range from 1 to 5. Some other programs have used a similar approach (e.g., Weisberg et al. 1997), while others have instead computed the IBI as the total of individual metric scores. For example, Karr et al. (1986) calculated IBI as the sum of 12 metric scores, with totals ranging from 12 to 60 points.

Reptiles and Amphibians

At each sample segment, reptiles and amphibians were identified and the presence of observed species was recorded during the summer index period. A search of the riparian area was conducted within 5 meters of the stream on both sides of the 75-meter segment. Any reptiles and amphibians collected during the electrofishing of the stream segment were also included in the species list. Individuals were identified to species when possible. Voucher specimens and individuals not positively identifiable in the field were retained for examination in the laboratory and confirmation by herpetologists at the Smithsonian Institution, Washington, DC, or Towson University, Towson, Maryland.

Physical Habitat

Habitat assessments were conducted at all stream segments as a means of assessing the importance of physical habitat to the biological integrity and fishability of freshwater streams in Maryland. Procedures for habitat assessments (Kazyak 1996) were derived from two currently used methodologies: EPA's Rapid

Bioassessment Protocols (RBPs) (Plafkin et al. 1989), as modified by Barbour and Stribling (1991), and the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) (Ohio EPA 1987, Rankin 1989). A number of characteristics (instream habitat, epifaunal substrate, velocity/depth diversity, pool/glide/eddy quality, riffle/run quality, channel alteration, bank stability, embeddedness, channel flow status, and shading) were assessed qualitatively, based on visual observations within each 75-meter sample segment. Riparian zone vegetation width was estimated to the nearest meter, up to 50 meters from the stream. Additional observations of the surrounding area were used to assign ratings for aesthetic value (based on visible signs of human refuse at a site) and remoteness (based on distance from the nearest road, accessibility, and evidence of human activity). Also recorded were the presence or absence of various stream features including substrate types, various morphological characteristics, beaver ponds, point sources, and stream channelization. Local land uses visible from the stream segment and riparian vegetation type were also noted. Several additional physical characteristics were measured quantitatively to further characterize the habitat for each segment (see Kazyak 1996 for details). Quantitative measurements of the segment included maximum depth, stream gradient, velocity, thalweg depth, number of functional rootwads, number of functional large woody debris, wetted width, sinuosity, and overbank flood height. A velocity/depth profile was measured or other data were collected to enable calculation of discharge.

Physical Habitat Index

The Physical Habitat Index (PHI) was developed using MBSS data from 1994 to 1997 (Hall et al. 1999). As was the case in development of the fish and benthic IBIs, the conceptual approach was based on evaluating the relative importance (discriminatory power) of individual metrics and combinations of metrics explaining natural differences in streams throughout Maryland. These metrics were derived from both quantitative and qualitative habitat data collected during the summer index period. Based on analyses conducted for both fish IBI (Roth et al. 1998) and benthic macroinvertebrate IBI (Stribling et al. 1998) development in Maryland, the State was divided into two regions: the Coastal Plain and non-Coastal Plain. The resulting index was then adjusted to a centile scale that rated each sample segment as follows: Good - 72 to 100; Fair - 42 to 71.9; Poor - 12 to 41.9; and Very Poor - 0 to 11.9.

Water Chemistry

During the spring index period, water samples were collected at each site for analysis of pH, acid neutralizing capacity (ANC), conductivity, sulfate, nitrate-nitrogen, and dissolved organic carbon (DOC). These variables describe basic water quality conditions with an emphasis on factors related to acidic deposition.

Grab samples were collected in one-liter bottles for analysis of all analytes except pH. Water samples for pH were collected with 60 ml syringes, which allowed purging of air bubbles to minimize changes in carbon dioxide content (EPA 1987). Samples were stored on wet ice and shipped on wet ice to the analytical laboratory within 48 hours. Laboratory analyses were carried out by the University of Maryland's Appalachian Laboratory in Frostburg.

Chemical analysis of water samples followed standard methods described in EPA's Handbook of Methods for Acid Deposition Studies (EPA 1987). EPA protocols were followed, except that ANC sample volume was reduced to 40 ml to ease handling. Routine daily quality control (QC) checks included processing duplicate, blank, and calibration samples according to EPA guidelines for each analyte. Field duplicates were taken at 5% of all sites. Routine QC checks helped to identify and correct errors in sampling routines or instrumentation at the earliest possible stage.

During the summer index period, in situ measurements of dissolved oxygen (DO), pH, temperature, and conductivity were collected at each site to further characterize existing water quality conditions that might influence biological communities. Measurements were made at an undisturbed section of the segment, usually in the middle of the stream channel, using electrode probes. Instruments were calibrated daily and calibration logbooks were maintained to document instrument performance.

Recognizing that water temperature is an important factor affecting stream condition, but one that varies daily and seasonally, temperature loggers were deployed at 220 sites in five basins during 1997. The basins sampled were: the Choptank, Susquehanna, Potomac Washington Metro, Patuxent, and Pocomoke. Onset Computer Corporation Optic Stowaway temperature loggers were anchored in each site during the summer index period. Water temperature was recorded every 15 minutes from June 15 until mid-September.

Mussels

During the summer index period, freshwater mussels were sampled qualitatively by examining each 75-meter stream segment for their presence. Mussels were identified to species, their presence recorded, and subsequently released. Species not positively identifiable in the field were retained for confirmation by U.S. Geological Survey (USGS) Biological Resources Division staff.

Aquatic Vegetation

Aquatic vegetation was sampled qualitatively by examining each 75-meter segment for the presence of aquatic plants. Plants were identified to species and their presence recorded for each site. While the primary objective was to document the presence of submerged aquatic vegetation (SAV), emergent and floating aquatic vegetation was also recorded when encountered. Species not positively identifiable in the field were retained for laboratory examination and confirmation by MDNR's staff expert on SAV. Due to the difficulty in long-term preservation, no permanent vouchers of aquatic vegetation were retained.

Data Management

All crews used standardized pre-printed data forms developed for the Survey to ensure that all data for each sampling segment were recorded and standard units of measure were used (Kazyak 1996). Using standard data forms facilitated data entry and minimized transcription error. The field crew leader and a second reviewer checked all data sheets for completeness and legibility before leaving each sampling location. Original data sheets were sent to the Data Management Officer for further review and data entry, while copies were retained by the field crews.

A custom database application, in which the input module was designed to match each of the field data sheets, was used for data entry. Data were independently entered into two databases and compared using a computer program as a quality-control procedure. Differences between the two databases were resolved from original data sheets or through discussions with field crew leaders.

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Maryland Biological Stream Survey Data

COUNTY SUMMARY

A total of 66 sites were sampled in Allegany county by MBSS sampling crews during 1994-1997 (Table 1; Figure 2). Qualitative fish sampling was conducted at an additional 26 sites to provide a more complete picture of fish species distributions. Appendix A provides a summary of the types of data available for each of the sites sampled.

Species Highlights

A total of 32 fish species were collected in the small to mid-sized streams, ranking Allegany County in the bottom one-third among counties in the state. Unlike other counties, a relatively high percentage (21%) of the sites sampled contained no fish (Table 2). The likely reasons for this are lower annual precipitation and the fractured nature of the underlying geology. The 155 genera of benthic macroinvertebrates collected tied the county for a ranking of thirteenth statewide. However, 30% of these taxa were found at a single site (<2% occurrence) and many appear to be rare on a statewide basis (Table 3).

Blacknose dace, creek chub, and white sucker, all pollution-tolerant species, were the most commonly encountered fishes (Table 2). In contrast, pollution-sensitive brook trout, once common in Allegany county streams prior to widespread clearcutting of forests, were found at only 5% of the streams sampled by the MBSS. No state or federally listed fish species were collected.

Twenty-four species of reptiles and amphibians were found in or near Allegany streams (Table 4), tying the county with Montgomery County for a ranking of second in the state, just behind Prince George's county. Both Prince George's and Montgomery counties are near or at the fall line (a distinct habitat change from sandy soils and low gradient to rocks and moderate slopes), so the higher number of herpetofauna in these regions is explained by habitat diversity. No state or federally listed reptiles or amphibians were collected during sampling in Allegany, but several of species found have restricted distributions or low abundance in the state. These species include eastern worm snake, eastern smooth earth snake, wood turtle, and northern spring salamander.

Ecological Health

The overall ecological health of Allegany county's headwater streams can be best described as Fair to Poor, and conditions are generally less favorable for fish than for benthic macroinvertebrates. This difference between indicators is, in part, explained by the greater importance of stream flow to fish compared to benthos, and the low flow conditions which naturally persist in the county during dry summers.

The average F-IBI score among sites was 2.31 (rating of Poor), and the average B-IBI score among sites was 3.1 (rating of Fair). Based on F-IBI and B-IBI scores, the highest rated streams in the county are Fifteenmile Creek, Evitt's Creek, and White Sulphur Run (Table 5). The lowest rated streams are George's Creek, Braddock Run, Sawpit Run, an unnamed tributary to Jenning's Run, and an unnamed tributary to the Potomac River.

Physical Habitat

Physical habitat in Allegany County was rated as Poor by the Physical Habitat Index. Values ranged from 3.2 to 93.5, with an average score of 27.63 (mid-range of the Poor category, ranking second to last among counties in the state) (Table 6; Figure 5). Other noteworthy points about Allegany County streams include ranking last in the state for both large woody debris abundance and instream rootwads (trees whose roots protect banks from erosion and provide habitat for aquatic life). However, instream habitat and epifaunal substrate, with an average rating of 11 and 9, respectively, ranked among the top fifteen scores in the state.

Nitrate-Nitrogen

Nitrate-nitrogen values at sites sampled in Allegany county were generally low and averaged 0.56 mg/L, for a ranking of third best in the state. The highest values for nitrate-nitrogen were found in less forested catchments of the county, with low values uniformly observed in the Fifteenmile Creek and Sideling Hill watersheds (Table 7). The worst streams for nitrate were unnamed tributaries to Will's Creek and the Potomac River. In no stream was the EPA limit for drinking water (10 mg/L) exceeded.

Table 1. Site information and land use data collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Basin abbreviations are as follows: NO - North Branch Potomac River; UP - Upper Potomac River.

Site	Latitude	Longitude	Stream Name	Basin	Order	Catchment Acres	% Urban	% Agric.	% Forest
AL-A-007-304-96	39.7020	78.8449	North Br Of Jennings Run	NO	3	8010.31	0.45	17.71	80.35
AL-A-020-228-95	39.6192	78.5287	Maple Run	UP	2	1335.26	0.00	1.71	97.94
AL-A-027-205-95	39.6753	78.4331	Terrapin Run	UP	2	2185.65	0.00	2.83	93.44
AL-A-027-209-95	39.6733	78.4334	Terrapin Run	UP	2	2428.11	0.00	2.55	94.10
AL-A-033-314-95	39.7107	78.4506	Fifteenmile Creek	UP	3	9142.73	0.00	5.70	86.54
AL-A-054-320-96	39.5164	79.0213	Georges Cr	NO	3	38903.56	3.35	5.40	82.28
AL-A-061-125-95	39.6400	78.4646	Ut Deep Run	UP	1	112.61	0.00	0.00	100.00
AL-A-069-102-95	39.6392	78.5025	White Sulphur Run	UP	1	61.98	0.00	0.00	100.00
AL-A-143-226-95	39.6584	78.3974	Ut Fifteenmile Creek	UP	2	1386.92	0.00	21.23	78.77
AL-A-146-301-95	39.6917	78.4523	Fifteenmile Creek	UP	3	12932.74	0.00	4.35	89.58
AL-A-148-201-96	39.5605	78.6242	Seven Springs Run	NO	2	1016.30	0.00	15.11	84.62
AL-A-167-230-95	39.6957	78.4560	Ut Fifteenmile Creek	UP	2	2043.51	0.00	1.08	96.90
AL-A-171-206-95	39.7139	78.4786	Ut Fifteenmile Creek	UP	2	373.49	0.00	1.10	96.53
AL-A-177-232-95	39.6478	78.4626	Deep Run	UP	2	3482.39	0.00	1.05	98.94
AL-A-187-218-96	39.4831	78.9617	Un Trib To Potomac R	NO	2	914.23	0.00	0.56	99.44
AL-A-199-122-95	39.7039	78.4127	Ut Terrapin Run	UP	1	206.85	0.00	0.66	99.34
AL-A-202-121-96	39.5989	78.8563	Warrior Run	NO	1	1257.87	0.00	1.62	91.77
AL-A-207-307-95	39.6867	78.4557	Fifteenmile Creek	UP	3	13170.94	0.00	4.27	89.77
AL-A-215-112-95	39.6158	78.5121	Ut Maple Run	UP	1	215.67	0.00	0.00	100.00
AL-A-221-107-96	39.5229	79.0136	Un Trib To Georges Cr	NO	1	1217.38	0.08	6.07	80.96
AL-A-232-313-96	39.6546	78.9403	Sand Spring Run	NO	3	1902.63	5.38	12.15	81.56
AL-A-233-601-96	39.6816	78.6711	Elk Lick Run	NO	3	1575.28	2.23	16.47	81.14
AL-A-244-227-95	39.6384	78.4116	Flat Run	UP	2	802.86	0.00	4.07	95.63
AL-A-248-213-95	39.5513	78.5753	Sawpit Run	UP	2	2496.67	0.01	9.71	90.28
AL-A-248-234-95	39.5483	78.5638	Sawpit Run	UP	2	3134.26	0.01	8.51	91.44
AL-A-254-326-96	39.6379	78.8487	Braddock Run	NO	3	6460.85	4.03	8.43	83.74
AL-A-255-108-95	39.5815	78.4671	Ut Potomac R	UP	1	203.16	0.00	0.17	99.83
AL-A-268-221-96	39.5627	78.6318	Seven Springs Run	NO	2	307.58	0.00	6.86	93.14
AL-A-276-323-96	39.7008	78.6980	Evitts Cr	NO	3	43859.18	0.17	17.26	81.16
AL-A-281-104-96	39.4593	78.9877	Dry Run	NO	1	335.14	0.00	0.71	99.29
AL-A-294-325-96	39.5585	78.6186	Trading Run	NO	3	5321.38	0.03	9.03	89.43
AL-A-296-226-96	39.7056	78.8968	Un Trib To Jennings Run	NO	2	1338.17	0.00	7.22	92.65
AL-A-318-126-95	39.6925	78.3607	Ut Sidling Hill Creek	UP	1	398.68	0.00	7.28	92.72
AL-A-319-219-96	39.7114	78.7191	Pea Vine Run	NO	2	2219.40	0.15	11.91	80.72
AL-A-343-307-96	39.5100	79.0423	Georges Cr	NO	3	43959.89	2.97	5.72	82.39
AL-A-343-330-96	39.5070	79.0443	Georges Cr	NO	3	44198.74	2.96	5.74	82.41
AL-A-373-113-96	39.5633	78.6307	Un Trib To Seven Springs Run	NO	1	187.47	0.00	30.60	69.40
AL-A-380-303-96	39.5992	78.6548	Mill Run	NO	3	3589.21	0.02	8.14	91.64
AL-A-392-316-95	39.7072	78.3384	Ut Sidling Hill Creek	UP	3	3392.86	3.43	28.96	67.59
AL-A-392-318-95	39.7071	78.3367	Ut Sidling Hill Creek	UP	3	3419.30	3.62	28.73	67.63
AL-A-413-308-96	39.6415	78.8598	Braddock Run	NO	3	6083.18	3.93	8.83	83.37
AL-A-419-106-95	39.6905	78.3904	Ut Fifteenmile Creek	UP	1	145.23	7.53	11.53	80.94
AL-A-425-314-96	39.6775	78.7075	Elk Lick Run	NO	3	3442.90	2.77	12.28	84.67
AL-A-441-309-95	39.6606	78.4625	White Sulphur Run	UP	3	4346.70	0.00	0.88	99.04
AL-A-465-311-96	39.5872	78.7176	Collier Run	NO	3	6298.89	0.03	10.79	89.06
AL-A-465-324-96	39.6052	78.7043	Collier Run	NO	3	5645.29	0.03	10.69	89.26
AL-A-480-205-96	39.6304	78.6416	Mill Run	NO	2	1103.40	0.03	19.15	80.79
AL-A-485-220-96	39.5884	78.8539	Un Trib To Potomac R	NO	2	798.89	0.47	0.64	97.23

Table 1 (cont.). Site information and land use data collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Basin abbreviations are as follows: NO - North Branch Potomac River; UP - Upper Potomac River.

Site	Latitude	Longitude	Stream Name	Basin	Order	Catchment Acres	% Urban	% Agric.	% Forest
AL-A-485-227-96	39.5803	78.8472	Un Trib To Potomac R	NO	2	1124.84	10.94	5.27	82.51
AL-A-500-103-95	39.6367	78.4968	Ut White Sulphur Run	UP	1	158.93	0.00	0.00	100.00
AL-A-524-211-95	39.6623	78.4050	Ut Fifteenmile Creek	UP	2	1929.02	3.28	8.97	87.72
AL-A-550-204-96	39.5757	78.6873	Un Trib To Brice Hollow Run	NO	2	1631.12	0.00	12.04	87.52
AL-A-553-306-95	39.7081	78.5677	Flintstone Creek	UP	3	18943.41	0.02	11.53	88.29
AL-A-578-110-96	39.5369	78.9180	Un Trib To Mill Run	NO	1	352.83	0.00	0.00	100.00
AL-A-585-122-96	39.5829	78.8312	Un Trib To Potomac R	NO	1	383.11	1.43	51.52	45.19
AL-A-598-602-96	39.6045	78.9459	Georges Cr	NO	3	11361.81	7.60	10.35	76.29
AL-A-626-216-96	39.5461	78.9096	Mill Run	NO	2	500.84	0.00	0.00	100.00
AL-A-635-113-95	39.6663	78.5522	Ut Town Creek	UP	1	81.99	0.00	0.82	99.18
AL-A-646-207-95	39.6009	78.4443	Ut Potomac R	UP	2	850.10	0.04	0.28	99.68
AL-A-688-319-95	39.6981	78.4503	Fifteenmile Creek	UP	3	9795.52	0.00	5.33	87.41
AL-A-706-228-96	39.6641	78.6599	Collier Run	NO	2	961.52	0.00	2.16	97.84
AL-A-709-303-95	39.7172	78.4458	Fifteenmile Creek	UP	3	6341.52	0.01	7.25	83.52
AL-A-726-115-96	39.6365	78.8753	Un Trib To Braddock Run	NO	1	127.25	0.00	0.00	100.00
AL-A-729-119-95	39.6673	78.4892	Ut Piclic Run	UP	1	61.98	0.00	0.55	99.45
AL-A-731-313-95	39.6647	78.6138	Murley Branch	UP	3	3312.73	0.03	32.12	67.84
AL-A-999-117-96	39.7128	78.7701	Un Trib To Wills Cr	NO	1	439.59	0.00	0.62	98.22

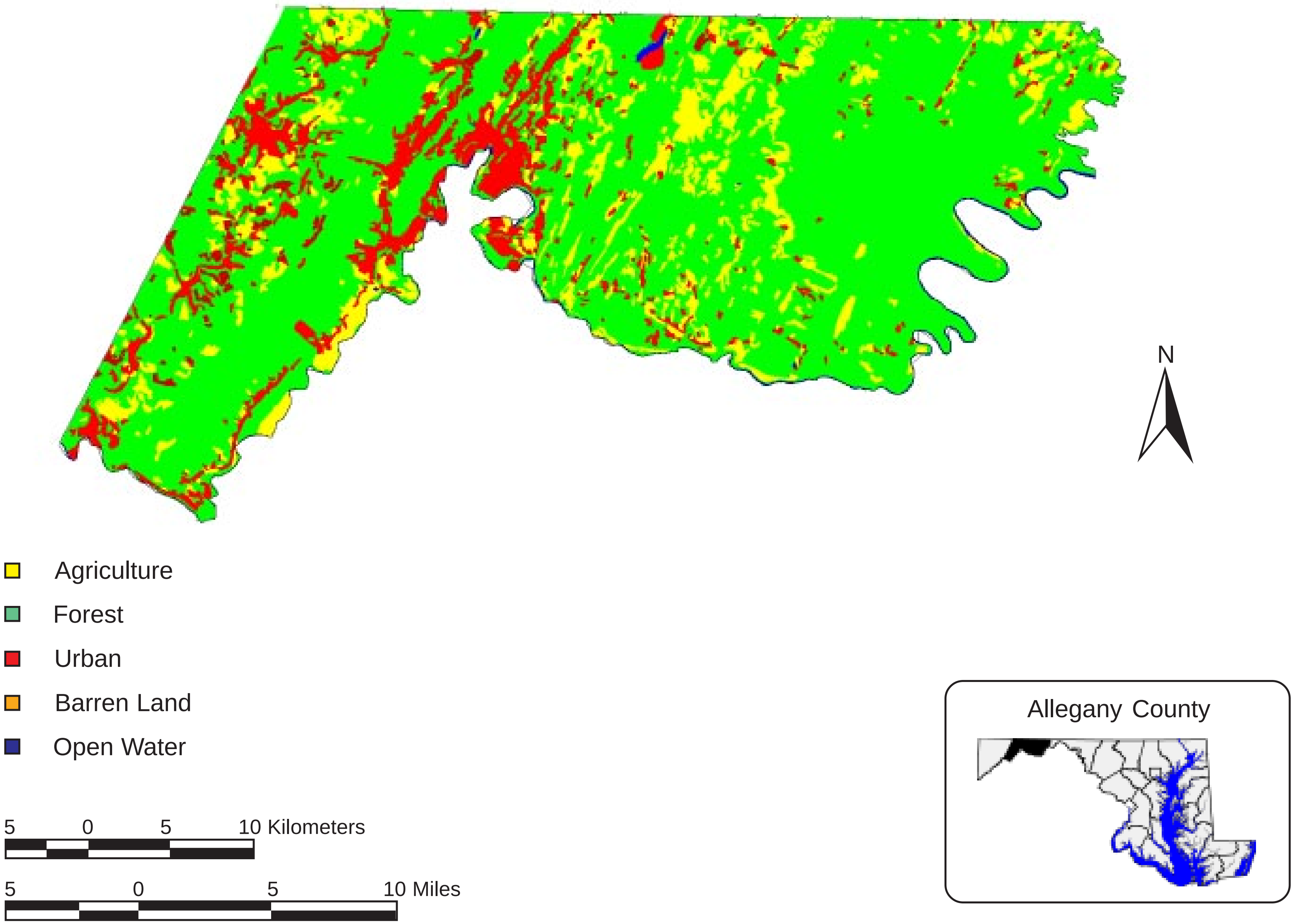

Figure 1. Land use in Allegany County (MOP 1994).

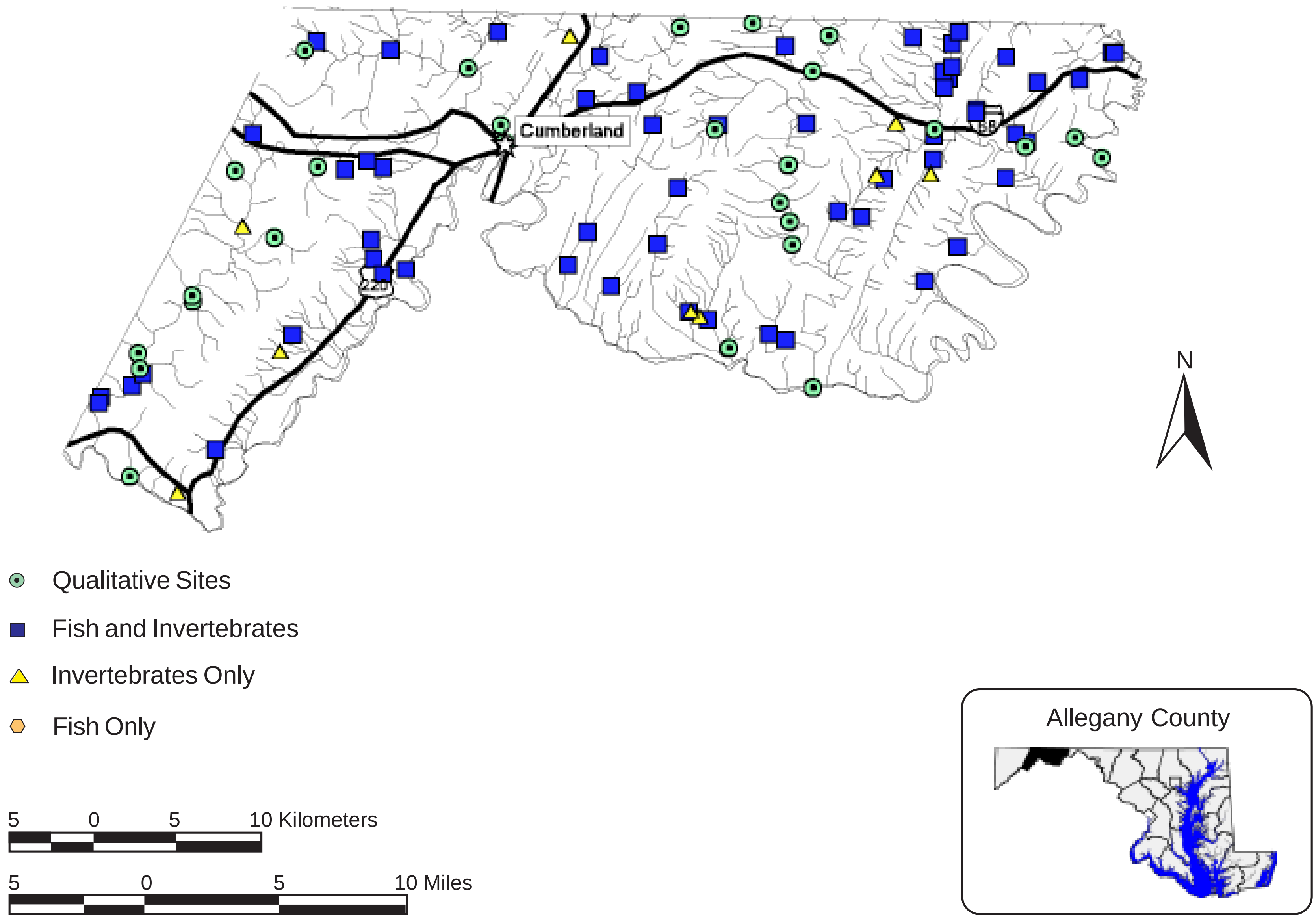

Figure 2. Location of Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Table 2. Percent occurrence of fish species collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Family	Common Name	Scientific Name	Number of Occurrences	Percent Occurrence
Anguillidae	American eel	*Anguilla rostrata*	1	1.75
Cyprinidae	central stoneroller	*Campostoma anomalum*	12	21.05
	rosyside dace	*Clinostomus funduloides*	3	5.26
	spotfin shiner	*Cyprinella spiloptera*	2	3.51
	common carp [1]	*Cyprinus carpio*		
	cutlips minnow	*Exoglossum maxillingua*	1	1.75
	common shiner	*Luxilus cornutus*	3	5.26
	river chub [1]	*Nocomis micropogon*		
	golden shiner [1]	*Notemigonus crysoleucas*		
	spottail shiner [1]	*Notropis hudsonius*		
	rosyface shiner [1]	*Notropis rubellus*		
	bluntnose minnow	*Pimephales notatus*	11	19.30
	blacknose dace	*Rhinichthys atratulus*	43	75.44
	longnose dace	*Rhinichthys cataractae*	14	24.56
	creek chub	*Semotilus atromaculatus*	31	54.39
	fallfish	*Semotilus corporalis*	5	8.77
Catostomidae	white sucker	*Catostomus commersoni*	21	36.84
	creek chubsucker	*Erimyzon oblongus*	5	8.77
	northern hogsucker	*Hypentelium nigricans*	4	7.02
	golden redhorse	*Moxostoma erythrurum*	1	1.75
Ictaluridae	yellow bullhead	*Ameiurus natalis*	2	3.51
	margined madtom [1]	*Noturus insignis*		
Esocidae	chain pickerel	*Esox niger*	6	10.53
Salmonidae	cutthroat trout [1]	*Oncorhynchus clarki*		
	rainbow trout	*Oncorhynchus mykiss*	7	12.28
	brown trout	*Salmo trutta*	1	1.75
	brook trout	*Salvelinus fontinalis*	3	5.26
Cottidae	mottled sculpin	*Cottus bairdi*	8	14.04
	Potomac sculpin	*Cottus girardi*	19	33.33
Centrarchidae	rock bass	*Ambloplites rupestris*	10	17.54
	redbreast sunfish	*Lepomis auritus*	2	3.51
	green sunfish	*Lepomis cyanellus*	10	17.54
	pumpkinseed	*Lepomis gibbosus*	1	1.75
	bluegill	*Lepomis machrochirus*	4	7.02
	longear sunfish [1]	*Lepomis megalotis*		
	smallmouth bass	*Micropterus dolomieu*	9	15.79
	largemouth bass	*Micropterus salmoides*	3	5.26
	black crappie [1]	*Pomoxis nigromaculatus*		
Percidae	greenside darter	*Etheostoma blennioides*	11	19.30
	rainbow darter	*Etheostoma caeruleum*	1	1.75
	fantail darter	*Etheostoma flabellare*	18	31.58
	tessellated darter [1]	*Etheostoma olmstedi*		
	yellow perch [1]	*Perca flavescens*		
None			12	21.05

[1] Qualitative Sites

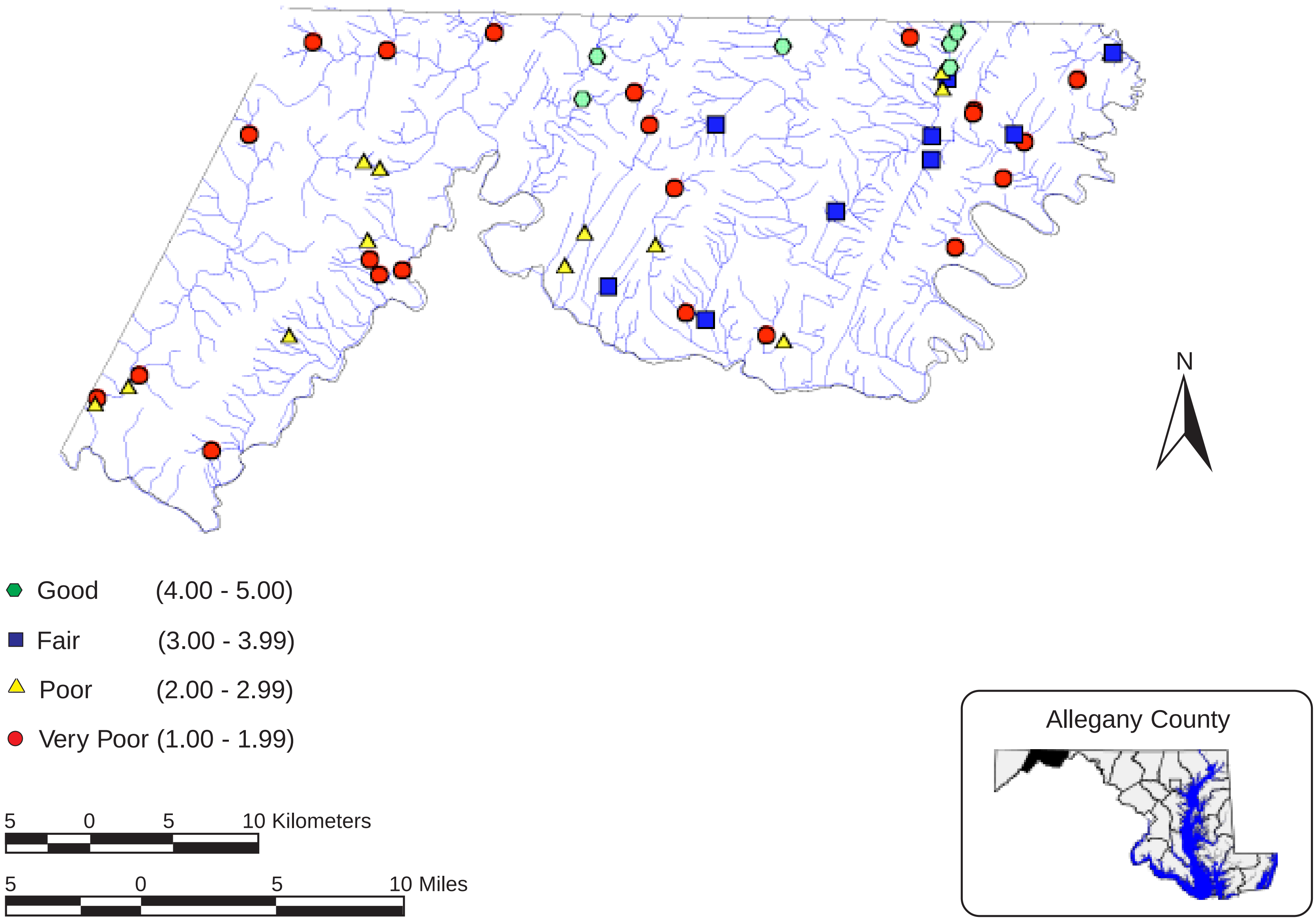

Figure 3. Stream ecological conditions based on the Fish Index of Biotic Integrity (F-IBI) at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Table 3. Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
Turbellaria	Tricladida	Planariidae	*Cura* Sp.			sp	1.52
			Dugesia Sp.	7	Predator	sp	1.52
Oligochaeta	Lumbriculida	Lumbriculidae		10	Collector	bu	21.21
Oligochaeta	Tubificida	Enchytraeidae		10	Collector	bu	4.55
		Naididae		10	Collector	bu	3.03
		Tubificidae		10	Collector	cn	3.03
			Limnodrilus Sp.	10	Collector	cn	1.52
Gastropoda	Basommatophora	Lymnaeidae	*Fossaria* Sp.	8	Scraper	cb	1.52
		Physidae	*Physella* Sp.	8	Scraper	cb	1.52
		Planorbidae	*Gyraulus* Sp.	8	Scraper	cb	3.03
			Planorbella Sp.	7	Scraper	cb	1.52
Gastropoda	Mesogastropoda	Pleuroceridae	*Leptoxis* Sp.		Scraper	cb	1.52
Malacostraca	Amphipoda					sp	1.52
		Crangonyctidae	*Crangonyx* Sp.	4	Collector	sp	6.06
		Gammaridae	*Gammarus* Sp.	6	Shredder	sp	10.61
Malacostraca	Decapoda	Cambaridae		6	Shredder	sp	15.15
			Cambarus Sp.	6	Collector	sp	1.52
Malacostraca	Isopoda	Asellidae	*Caecidotea* Sp.	8	Collector	sp	33.33
Insecta	Ephemeroptera				Collector		1.52
		Ameletidae	*Ameletus* Sp.	0	Collector	sw, cb	59.09
		Baetidae			Collector	sw, cn	6.06
			Acentrella Sp.	4	Collector	sw, cn	3.03
			Acerpenna Sp.	4	Collector	sw, cn	13.64
			Baetis Sp.	6	Collector	sw, cb, cn	9.09
			Diphetor Sp.		Collector	sw, cn	3.03
		Caenidae	*Caenis* Sp.	7	Collector	sp	3.03
		Ephemerellidae				cn, sp, sw	1.52
			Drunella Sp.	1	Scraper	cn, sp	3.03
			Ephemerella Sp.	2	Collector	cn, sw	60.61
			Eurylophella Sp.	4	Scraper	cn, sp	15.15
			Satella Sp.	2	Collector	cn	3.03
		Ephemeridae	*Ephemera* Sp.	3	Collector	bu	1.52
		Heptageniidae			Scraper	cn	10.61
			Cinygmula Sp.		Scraper	cn	18.18
			Epeorus Sp.	0	Scraper	cn	53.03
			Heptagenia Sp.	4	Scraper	cn, sw	3.03
			Leucrocuta Sp.	1	Scraper	cn	6.06
			Nixe Sp.	2	Scraper	cn	1.52
			Stenacron Sp.	4	Collector	cn	6.06
			Stenonema Sp.	4	Scraper	cn	25.76
		Isonychiidae	*Isonychia* Sp.	2	Filterer	sw, cn	6.06
		Leptophlebiidae	*Paraleptophlebia* Sp.	2	Collector	sw, cn, sp	34.85
Insecta	Odonata	Cordulegastridae	*Cordulegaster* Sp.	3	Predator	bu	1.52
		Gomphidae			Predator	bu	1.52
			Lanthus Sp.	6	Predator	bu	3.03
		Gomphidae	*Stylogomphus* Sp.		Predator	bu	3.03
Insecta	Plecoptera	Capniidae	*Allocapnia* Sp.	3	Shredder	cn	3.03

Table 3 (cont.). Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
			Paracapnia Sp.	1	Shredder	-	4.55
		Chloroperlidae			Predator	cn	9.09
			Haploperla Sp.		Predator	cn	1.52
			Sweltsa Sp.		Predator	cn	46.97
		Leuctridae			Shredder	sp, cn	6.06
			Leuctra Sp.	0	Shredder	cn	50.00
		Nemouridae			Shredder	sp, cn	15.15
			Amphinemura Sp.	3	Shredder	sp, cn	62.12
			Ostrocerca Sp.		Shredder	sp, cn	40.91
			Prostoia Sp.		Shredder	sp, cn	16.67
		Peltoperlidae			Shredder	cn, sp	3.03
			Peltoperla Sp.		Shredder	cn, sp	4.55
		Perlidae			Predator	cn	3.03
			Acroneuria Sp.	0	Predator	cn	21.21
			Eccoptura Sp.		Predator	cn	1.52
		Perlodidae			Predator	cn	28.79
			Clioperla Sp.	1	Predator	cn	7.58
			Isoperla Sp.	2	Predator	cn, sp	34.85
		Pteronarcyidae	*Pteronarcys* Sp.	2	Shredder	cn, sp	4.55
		Taeniopterygidae	*Oemopteryx* Sp.		Shredder	sp, cn	19.70
			Strophopteryx Sp.		Shredder	sp, cn	6.06
Insecta	Megaloptera	Corydalidae	*Nigronia* Sp.	0	Predator	cn, cb	7.58
		Sialidae	*Sialis* Sp.	4	Predator	bu, cb, cn	3.03
Insecta	Trichoptera	Glossosomatidae			Scraper	cn	1.52
			Agapetus Sp.	2	Scraper	cn	1.52
		Hydropsychidae			Filterer	cn	1.52
			Cheumatopsyche Sp.	5	Filterer	cn	24.24
			Diplectrona Sp.	2	Filterer	cn	27.27
			Homoplectra Sp.		Filterer	cn	1.52
			Hydropsyche Sp.	6	Filterer	cn	16.67
		Hydroptilidae	*Hydroptila* Sp.	6	Scraper	cn	1.52
			Ochrotrichia Sp.	4	Scraper	cn	1.52
		Lepidostomatidae	*Lepidostoma* Sp.	3	Shredder	cb, sp, cn	6.06
		Limnephilidae			Shredder	cb, sp, cn	4.55
			Ironoquia Sp.	3	Shredder	sp	6.06
			Limnephilus Sp.	3	Shredder	cb, sp, cn	1.52
		Philopotamidae	*Chimarra* Sp.	4	Filterer	cn	15.15
			Dolophilodes Sp.	0	Filterer	cn	19.70
			Wormaldia Sp.		Filterer	cn	13.64
		Polycentropodidae	*Polycentropus* Sp.	5	Filterer	cn	6.06
		Rhyacophilidae	*Rhyacophila* Sp.	1	Predator	cn	46.97
		Uenoidae	*Neophylax* Sp.	3	Scraper	cn	53.03
Insecta	Lepidoptera	Pyralidae			Shredder	cb	1.52
Insecta	Coleoptera	Elmidae	*Optioservus* Sp.	4	Scraper	cn	12.12
			Oulimnius Sp.	2	Scraper	cn	3.03
			Stenelmis Sp.	6	Scraper	cn	1.52
		Psephenidae	*Ectopria* Sp.	5	Scraper	cn	7.58

Table 3 (cont.). Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
			Psephenus Sp.	4	Scraper	cn	1.52
		Ptilodactylidae	*Anchytarsus* Sp.	4	Shredder	cn	4.55
Insecta	Diptera	Ceratopogonidae	*Bezzia* Sp.	6	Predator	bu	4.55
			Ceratopogon Sp.	6	Predator	sp, bu	6.06
			Culicoides Sp.	10	Predator	bu	1.52
			Probezzia Sp.	6	Predator	bu	6.06
		Chaoboridae	*Chaoborus* Sp.		Predator	sp, sw	1.52
		Chironomidae					1.52
			Brillia Sp.	5	Shredder	bu, sp	1.52
			Cardiocladius Sp.	6	Predator	bu, cn	3.03
			Conchapelopia Sp.	6	Predator	sp	25.76
			Corynoneura Sp.	7	Collector	sp	12.12
			Cricotopus Sp.	7	Shredder	cn, bu	3.03
			Cricotopus/ Orthocladius Sp.		Shredder		19.70
			Diamesa Sp.	5	Collector	sp	16.67
			Eukiefferiella Sp.	8	Collector	sp	33.33
			Heleniella Sp.		Predator	sp	7.58
			Larsia Sp.	6	Predator	sp	4.55
			Micropsectra Sp.	7	Collector	cb, sp	33.33
			Microtendipes Sp.	6	Filterer	cn	6.06
			Nanocladius Sp.	3	Collector	sp	1.52
			Orthocladius Sp.	6	Collector	sp, bu	13.64
			Parakiefferiella Sp.	4	Collector	sp	1.52
			Parametriocnemus Sp.	5	Collector	sp	63.64
			Paraphaenocladius Sp.	4	Collector	sp	1.52
			Paratanytarsus Sp.	6	Collector	sp	1.52
			Pentaneura Sp.	6	Predator	sp	1.52
			Phaenopsectra Sp.	7	Collector	cn	1.52
			Polypedilum Sp.	6	Shredder	cb, cn	22.73
			Potthastia Sp.	2	Collector	sp	1.52
			Psectrocladius Sp.	8	Shredder	sp, bu	1.52
			Pseudorthocladius Sp.	0	Collector	sp	1.52
			Rheocricotopus Sp.	6	Collector	sp	6.06
			Rheotanytarsus Sp.	6	Filterer	cn	3.03
			Stempellinella Sp.	4	Collector	cb, sp, cn	3.03
			Sympotthastia Sp.	2	Collector	sp	4.55
			Tanytarsus Sp.	6	Filterer	cb, cn	25.76
			Thienemanniella Sp.	6	Collector	sp	10.61
			Thienemannimyia Sp.		Predator	sp	3.03
			Trissopelopia Sp.		Predator	sp	1.52
			Tvetenia Sp.	5	Collector	sp	7.58
			DIAMESINAE		Collector		1.52
			ORTHOCLADIINAE		Collector		6.06
			TANYTARSINI		Collector		3.03
			Zavrelimyia Sp.	8	Predator	sp	3.03
		Empididae	*Clinocera* Sp.		Predator	cn	3.03

Table 3 (cont.). Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
			Hemerodromia Sp.	6	Predator	sp, bu	4.55
		Simuliidae		7	Filterer	cn	1.52
			Prosimulium Sp.	7	Filterer	cn	71.21
			Simulium Sp.	7	Filterer	cn	10.61
			Stegopterna Sp.	7	Filterer	cn	42.42
		Tabanidae	*Tabanus* Sp.	5	Predator	sp, bu	4.55
		Tipulidae			Predator	bu, sp	1.52
			Antocha Sp.	5	Collector	cn	6.06
			Dicranota Sp.	4	Predator	sp, bu	9.09
			Hexatoma Sp.	4	Predator	bu, sp	31.82
			Limnophila Sp.	4	Predator	bu	1.52
			Limonia Sp.	6	Shredder	bu, sp	1.52
			Ormosia Sp.		Collector	bu	4.55
			Pseudolimnophila Sp.	2	Predator	bu	9.09
			Tipula Sp.	4	Shredder	bu	9.09

[1] Tolerance values are on a 0 (extremely sensitive) to 10 (tolerant) scale.
[2] Taxa not identified to genus are presented in capital letters. Subfamily - Orthocladiinae, Diamesinae; Tribe - Tanytarsini.

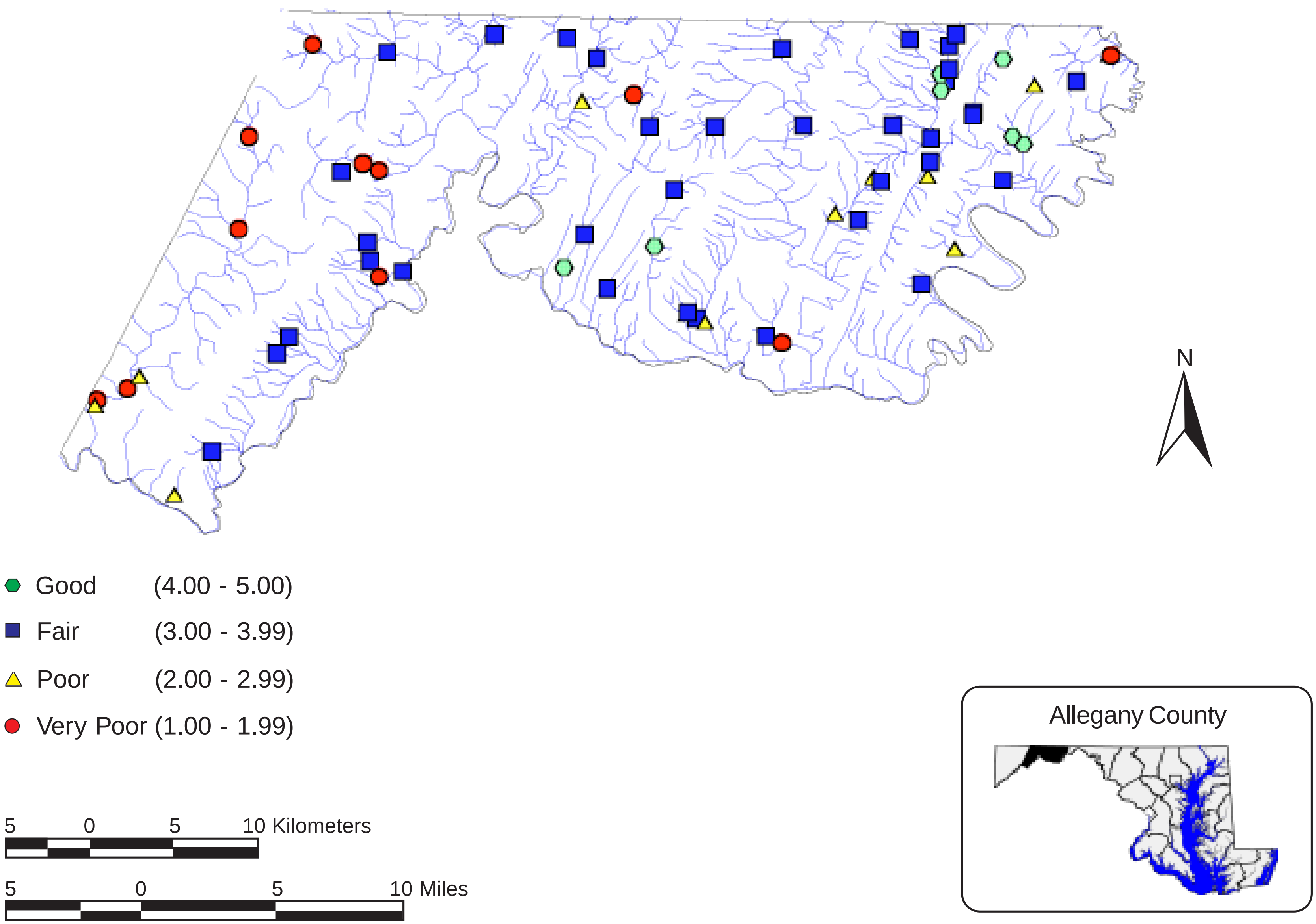

Figure 4. Stream ecological conditions based on the Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI) at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Table 4. Percent occurrence of reptile and amphibian species collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Family	Common Name	Scientific Name	Number of Occurrences	Percent Occurrence
Salamandridae	red spotted newt	*Notopthalmus v. viridescens*	3	5.26
Plethodontidae	longtail salamander	*Eurycea l. longicauda*	5	8.77
	mountain dusky salamander	*Desmognathus ochrophaeus*	2	3.51
	northern dusky salamander	*Desmognathus f. fuscus*	28	49.12
	northern two-lined salamander	*Eurycea bislineata*	35	61.40
	northern slimy salamander	*Plethodon glutinosus*	6	10.53
	northern spring salamander	*Gyrinophilus p. porphyriticus*	5	8.77
	red salamander	*Pseudotriton ruber*	11	19.30
	redback salamander	*Plethodon cinereus*	1	1.75
Phrynosomatidae	seal salamander	*Sceloporus undulatus hyacinthinus*	2	3.51
Bufonidae	American toad	*Bufo americanus*	5	8.77
Ranidae	bullfrog	*Rana catesbeiana*	5	8.77
	green frog	*Rana clamitans melanota*	10	17.54
	pickerel frog	*Rana palaustris*	2	3.51
	wood frog	*Rana sylvatica*	3	5.26
Emydidae	eastern box turtle	*Terrapene c. carolina*	5	8.77
	wood turtle	*Clemmys insculpta*	1	1.75
Scincidae	five-lined skink	*Eumeces fasciatus*	1	1.75
Colubridae	black rat snake	*Elaphe o. obsoleta*	1	1.75
	eastern garter snake	*Thamnophis s. sirtalis*	1	1.75
	eastern smooth earth snake	*Virginia v. valeriae*	1	1.75
	eastern worm snake	*Carphophis a. amoenus*	1	1.75
	northern ringneck snake	*Diadophis punctatus edwardsii*	1	1.75
	northern water snake	*Nerodia s. sipedon*	7	12.28
None			5	8.77

Table 5. Physical habitat data for Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Site	Instream Habitat[1]	Epifaunal Substrate[1]	Velocity/Depth Diversity[1]	Pool Quality[1]	Riffle Quality[1]	Percent Embeddedness[1]	Percent Shading[1]	Maximum Depth (cm)[1]	Number of Woody Debris	Number of Rootwads	Percent Channel Flow[1]	Channel Alteration[1]	Bank Stability[1]	Riparian Width (m)[1]	Aesthetic Rating[1]
AL-A-007-304-96	11	7	9	9	5	100	80	36	0	0	75	15	12	50	14
AL-A-020-228-95	1	1	2	1	0	90	90	20	1	0	2	11	5	50	20
AL-A-027-205-95	6	11	8	8	7	40	93	38	0	0	40	16	16	50	19
AL-A-027-209-95	8	11	7	14	7	100	97	36	2	0	45	16	15	50	19
AL-A-033-314-95	15	17	17	13	1a9	10	60	76	1	1	100	16	6	50	11
AL-A-054-320-96	16	5	16	16	5	70	60	64	0	0	75	4	16	0	2
AL-A-143-226-95	16	15	11	11	13	100	95	58	3	0	90	19	19	0	18
AL-A-146-301-95	13	11	11	16	16	40	30	65	0	1	75	14	15	50	17
AL-A-167-230-95	6	11	7	3	7	25	90	19	0	0	30	17	12	50	20
AL-A-171-206-95	6	12	4	2	3	100	50	8	0	0	15	18	15	0	20
AL-A-177-232-95	8	13	11	13	6	30	90	56	4	2	45	12	17	50	15
AL-A-187-218-96	9	5	11	16	7	25	93	50	0	0	40	10	17	50	20
AL-A-199-122-95	11	5	6	6	8	70	75	12	3	0	90	18	16	50	19
AL-A-202-121-96	13	17	10	11	16	40	90	40	1	1	80	16	17	0	16
AL-A-207-307-95	13	8	8	18	0	100	30	83	2	0	90	10	15	0	15
AL-A-215-112-95	15	15	8	10	11	100	90	29	3	0	80	16	13	50	19
AL-A-221-107-96	12	2	10	11	13	60	90	48	0	0	70	9	9	38	3
AL-A-232-313-96	18	10	13	16	14	60	85	59	0	0	100	13	18	0	5
AL-A-233-601-96	8	4	6	6	6	40	10	20	0	0	45	1	15	0	10
AL-A-244-227-95	7	5	3	7	6	0	95	32	1	0	40	19	17	50	19
AL-A-248-213-95	5	2	6	10	11	100	55	40	0	0	100	20	19	50	15
AL-A-248-234-95	16	5	16	16	15	100	25	70	0	0	100	18	16	28	19
AL-A-254-326-96	18	3	18	20	20	60	60	164	0	0	98	5	17	0	1
AL-A-255-108-95	10	5	6	4	6	100	95	19	0	0	45	18	18	50	20
AL-A-268-221-96	9	15	8	8	7	100	95	36	0	0	60	13	16	2	15
AL-A-276-323-96	16	18	7	12	15	25	35	46	0	0	100	19	19	0	11
AL-A-294-325-96	12	5	14	16	8	45	40	54	1	0	97	12	9	0	7
AL-A-296-226-96	16	1	13	16	5	75	90	52	0	0	75	13	12	50	5
AL-A-318-126-95	13	16	9	10	14	15	95	30	3	1	70	15	15	50	19
AL-A-343-307-96	16	11	11	17	15	80	25	165	1	0	95	11	17	11	1
AL-A-343-330-96	19	10	16	18	19	55	15	106	0	0	90	1	17	0	2
AL-A-380-303-96	12	12	10	14	13	65	95	46	0	2	96	10	11	7	15
AL-A-392-316-95	10	5	6	8	16	25	20	24	0	0	85	5	17	0	8
AL-A-392-318-95	12	10	12	9	10	15	65	60	0	0	75	12	17	0	9
AL-A-413-308-96	18	3	19	17	2	65	90	94	2	2	98	15	14	15	5
AL-A-419-106-95	5	5	6	3	6	40	96	14	2	0	40	17	13	50	19

Table 5 (cont.). Physical habitat data for Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Site	Instream Habitat[1]	Epifaunal Substrate[1]	Velocity/Depth Diversity[1]	Pool Quality[1]	Riffle Quality[1]	Percent Embeddedness[1]	Percent Shading[1]	Maximum Depth (cm)[1]	Number of Woody Debris	Number of Rootwads	Percent Channel Flow[1]	Channel Alteration[1]	Bank Stability[1]	Riparian Width (m)[1]	Aesthetic Rating[1]
AL-A-425-314-96	16	4	14	15	7	55	80	84	1	2	65	18	16	13	9
AL-A-441-309-95	16	5	12	16	6	20	70	46	3	0	50	16	13	0	19
AL-A-465-311-96	14	11	10	12	16	100	50	42	0	0	96	15	17	0	10
AL-A-465-324-96	15	15	8	10	10	100	97	34	0	0	94	9	17	50	18
AL-A-480-205-96	11	15	11	14	14	35	90	82	1	0	65	6	17	50	19
AL-A-485-220-96	13	16	11	15	10	45	96	49	1	0	45	15	18	50	6
AL-A-485-227-96	11	16	7	7	12	40	50	20	0	0	65	1	13	0	2
AL-A-500-103-95	6	11	6	3	6	20	95	20	1	1	35	19	17	50	19
AL-A-524-211-95	4	5	6	6	6	20	97	20	0	0	40	15	18	50	19
AL-A-550-204-96	9	5	8	10	8	100	70	42	0	0	95	6	16	0	7
AL-A-553-306-95	15	13	12	10	19	0	50	50	1	0	95	16	18	0	15
AL-A-585-122-96	14	5	9	12	10	60	92	38	0	1	70	11	15	50	12
AL-A-626-216-96	15	10	14	15	12	100	95	90	0	1	90	19	18	50	19
AL-A-635-113-95	1	1	2	1	1	100	90	12	0	0	10	20	18	30	0
AL-A-646-207-95	2	1	2	1	0	50	85	9	0	0	2	17	16	2	15
AL-A-688-319-95	13	14	12	12	17	10	90	70	0	2	99	18	18	50	16
AL-A-706-228-96	11	5	6	12	11	45	80	32	2	0	65	10	13	50	16
AL-A-709-303-95	8	5	12	11	14	100	65	54	0	0	100	16	13	13	6
AL-A-726-115-96	6	6	5	6	6	45	97	38	0	0	45	18	19	50	19
AL-A-731-313-95	15	16	9	10	16	20	60	42	0	0	90	11	11	1	12
AL-A-999-117-96	6	11	8	7	7	35	80	16	1	0	60	14	17	0	20

[1] MBSS Qualitative Habitat Metric - See Appendix B for Guidance

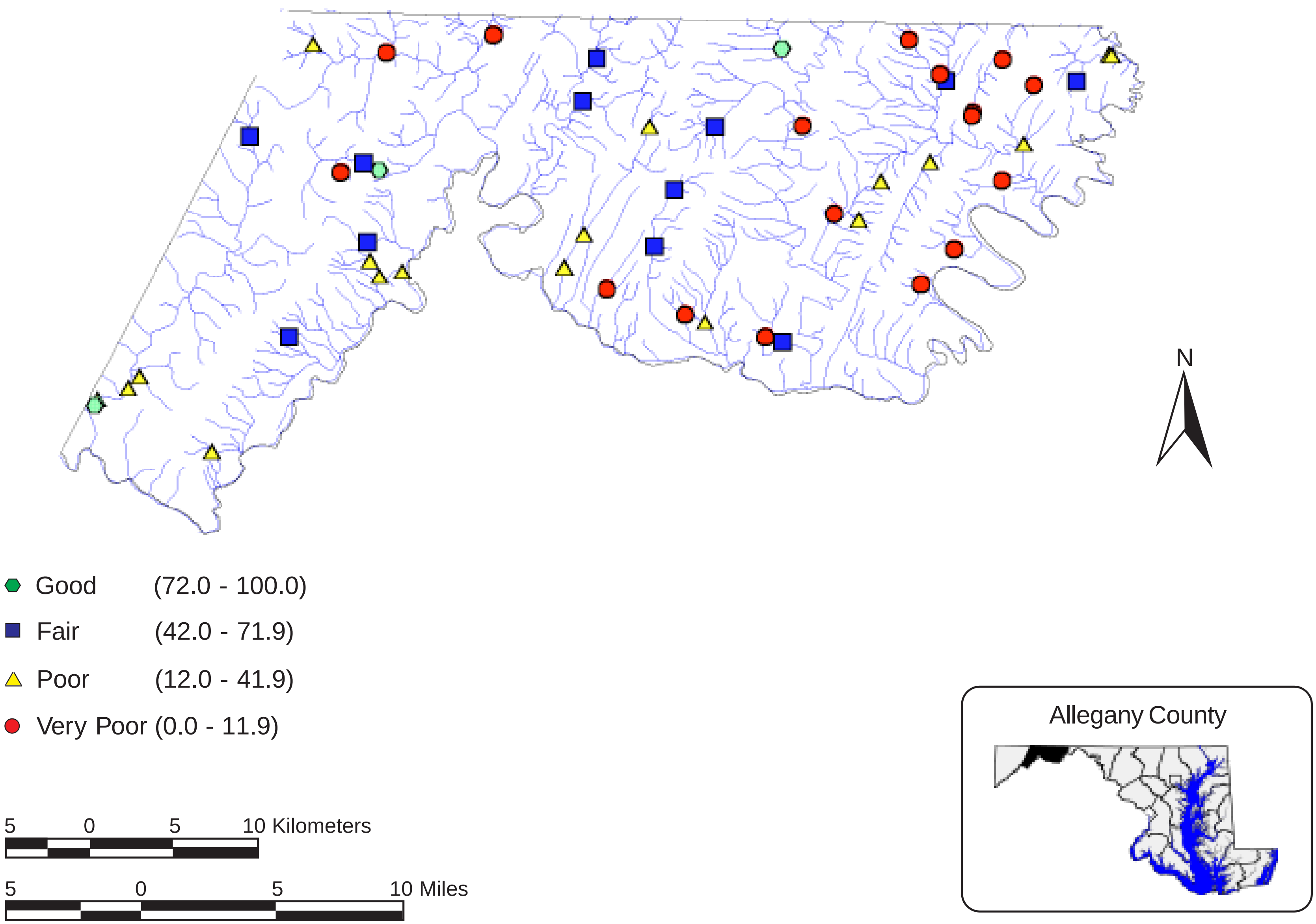

Figure 5. Stream ecological conditions based on thePhysical Habitat Index (PHI) at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Table 6. Fish Index of Biotic Integrity (F-IBI), Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI), and Physical Habitat Index (PHI) scores at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Site	Stream Name	F-IBI	B-IBI	PHI
AL-A-007-304-96	North Br Of Jennings Run	1.86	3.2	6.87
AL-A-020-228-95	Maple Run	3.57	2.6	0.71
AL-A-027-205-95	Terrapin Run	1.00	3.2	10.37
AL-A-027-209-95	Terrapin Run	1.29	3.4	5.89
AL-A-033-314-95	Fifteenmile Creek	4.14	3.9	
AL-A-054-320-96	Georges Cr	2.14	1.7	22.18
AL-A-061-125-95	Ut Deep Run		2.3	
AL-A-069-102-95	White Sulphur Run		2.3	
AL-A-143-226-95	Ut Fifteenmile Creek	1.57	4.3	35.43
AL-A-146-301-95	Fifteenmile Creek	3.86	3.9	61.41
AL-A-148-201-96	Seven Springs Run		3.2	
AL-A-167-230-95	Ut Fifteenmile Creek	2.14	4.3	11.36
AL-A-171-206-95	Ut Fifteenmile Creek	1.00	3.4	2.11
AL-A-177-232-95	Deep Run	3.00	3.4	27.51
AL-A-187-218-96	Un Trib To Potomac R	1.00	3.9	23.25
AL-A-199-122-95	Ut Terrapin Run		4.1	11.57
AL-A-202-121-96	Warrior Run	2.43	3.9	57.46
AL-A-207-307-95	Fifteenmile Creek	2.71	4.1	
AL-A-215-112-95	Ut Maple Run		3.4	21.48
AL-A-221-107-96	Un Trib To Georges Cr	1.00	2.3	20.79
AL-A-232-313-96	Sand Spring Run	1.86	1.9	49.33
AL-A-233-601-96	Elk Lick Run		1.7	
AL-A-244-227-95	Flat Run	1.00	3.7	9.29
AL-A-248-213-95	Sawpit Run	1.57	3.7	5.05
AL-A-248-234-95	Sawpit Run	2.14	1.4	57.46
AL-A-254-326-96	Braddock Run	2.14	1.4	76.15
AL-A-255-108-95	Ut Potomac R		3.7	6.12
AL-A-268-221-96	Seven Springs Run	1.00	2.6	6.36
AL-A-276-323-96	Evitts Cr	4.14	3.4	44.74
AL-A-281-104-96	Dry Run		2.8	
AL-A-294-325-96	Trading Run	3.86	2.6	24.75
AL-A-296-226-96	Un Trib To Jennings Run	1.00	1.7	17.33
AL-A-318-126-95	Ut Sidling Hill Creek	1.00	3.4	58.96
AL-A-319-219-96	Pea Vine Run		3.2	
AL-A-343-307-96	Georges Cr	1.29	1.7	30.90
AL-A-343-330-96	Georges Cr	2.14	2.6	73.45
AL-A-373-113-96	Un Trib To Seven Springs Run		3.4	
AL-A-380-303-96	Mill Run	2.14	4.3	45.76
AL-A-392-316-95	Ut Sidling Hill Creek	2.71	2.3	25.52
AL-A-392-318-95	Ut Sidling Hill Creek	3.57	1.2	34.04
AL-A-413-308-96	Braddock Run	2.14	1.4	47.80
AL-A-419-106-95	Ut Fifteenmile Creek		2.3	6.61
AL-A-425-314-96	Elk Lick Run	4.14	2.6	48.82
AL-A-441-309-95	White Sulphur Run	3.86	3.9	
AL-A-465-311-96	Collier Run	2.71	4.6	28.34
AL-A-465-324-96	Collier Run	2.43	3.9	18.84
AL-A-480-205-96	Mill Run	1.29	3.7	43.73
AL-A-485-220-96	Un Trib To Potomac R	1.00	3.2	23.99
AL-A-485-227-96	Un Trib To Potomac R	1.00	1.4	14.84

Table 6 (cont.). Fish Index of Biotic Integrity (F-IBI), Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI), and Physical Habitat Index (PHI) scores at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Site	Stream Name	F-IBI	B-IBI	PHI
AL-A-500-103-95	Ut White Sulphur Run		3.2	12.89
AL-A-524-211-95	Ut Fifteenmile Creek	3.00	4.3	
AL-A-550-204-96	Un Trib To Brice Hollow Run	3.00	3.9	5.25
AL-A-553-306-95	Flintstone Creek	4.71	3.2	77.61
AL-A-578-110-96	Un Trib To Mill Run		3.2	
AL-A-585-122-96	Un Trib To Potomac R	1.29	3.2	30.03
AL-A-598-602-96	Georges Cr		1.9	
AL-A-626-216-96	Mill Run	2.71	3.7	48.31
AL-A-635-113-95	Ut Town Creek		3.4	0.31
AL-A-646-207-95	Ut Potomac R	1.00	2.3	1.06
AL-A-688-319-95	Fifteenmile Creek	4.14	3.4	
AL-A-706-228-96	Collier Run	1.29	3.9	18.53
AL-A-709-303-95	Fifteenmile Creek	4.43	3.9	
AL-A-726-115-96	Un Trib To Braddock Run		3.4	6.24
AL-A-729-119-95	Ut Piclic Run		3.0	
AL-A-731-313-95	Murley Branch	3.86	3.4	53.42
AL-A-999-117-96	Un Trib To Wills Cr	1.00	3.9	11.36

Table 7. Water chemistry data collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Site	pH	Conductivity (µS/cm)	Acid Neutralizing Capacity (µeq/L)	Nitrate (mg/L)	Sulfate (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Organic Carbon (mg/L)
AL-A-007-304-96	7.46	0.246	515.90	1.177	73.513	7.70	1.20
AL-A-020-228-95	6.33	0.043	93.73	0.143	10.597	1.70	2.00
AL-A-027-205-95	6.94	0.115	183.60	0.171	14.624	8.20	2.00
AL-A-027-209-95	6.98	0.113	175.46	0.185	14.875	7.60	3.00
AL-A-033-314-95	7.07	0.047	182.15	0.323	10.027	8.20	2.00
AL-A-054-320-96	7.21	0.632	654.80	0.859	235.872	8.10	1.10
AL-A-061-125-95	6.12	0.048	33.65	0.200	17.200		2.00
AL-A-069-102-95	5.94	0.032	73.24		8.779		1.00
AL-A-143-226-95	6.84	0.066	138.19	0.577	15.442	9.20	2.00
AL-A-146-301-95	6.89	0.048	177.81	0.293	10.269	9.30	2.00
AL-A-148-201-96	7.85	0.202	1163.00	0.183	36.002		2.70
AL-A-167-230-95	6.91	0.047	131.04	0.159	11.097	5.70	1.00
AL-A-171-206-95	6.49	0.042	92.90	0.115	11.021	6.40	2.00
AL-A-177-232-95	6.70	0.051	94.23	0.160	14.913	3.40	2.00
AL-A-187-218-96	7.33	0.102	391.60	0.789	22.004	7.50	2.00
AL-A-199-122-95	6.60	0.106	74.56	0.354	11.412	8.40	2.00
AL-A-202-121-96	7.28	0.160	343.10	1.113	44.963	8.20	1.10
AL-A-207-307-95	6.91	0.055	172.95	0.256	10.337	7.40	2.00
AL-A-215-112-95	6.99	0.053	231.11	0.144	11.985	6.80	2.00
AL-A-221-107-96	4.98	0.981	-3.40	1.211	520.266	9.30	1.00
AL-A-232-313-96	7.01	0.345	175.70	0.795	22.083	7.40	2.40
AL-A-233-601-96	8.23	0.692	3364.50	1.585	71.875	8.60	1.20
AL-A-244-227-95	6.77	0.054	144.01	0.120	14.358	3.80	2.00
AL-A-248-213-95	6.69	0.084	291.05	0.135	21.552	7.90	2.00
AL-A-248-234-95	7.30	0.114	400.21		35.383	8.40	5.00
AL-A-254-326-96	7.97	0.861	308.70	0.594	346.426	10.10	0.80
AL-A-255-108-95	7.14	0.073	255.68	0.507	17.050	6.50	2.00
AL-A-268-221-96	7.24	0.130	475.20	0.303	28.983	6.00	3.30
AL-A-276-323-96	8.04	0.145	922.30	0.689	14.347	8.70	2.70
AL-A-281-104-96	6.88	0.112	119.80	0.910	31.191		2.20
AL-A-294-325-96	7.17	0.107	327.80	0.328	24.628	8.10	2.90
AL-A-296-226-96	4.14	0.297	-92.20	0.618	128.981	9.00	1.40
AL-A-318-126-95	6.53	0.071	59.65	0.210	12.606	8.10	2.00
AL-A-319-219-96	8.03	0.191	1334.10	0.526	19.500		1.90
AL-A-343-307-96	6.98	0.664	518.00	0.860	263.138	8.70	1.00
AL-A-343-330-96	7.41	0.745	678.30	0.673	349.541	8.70	1.90
AL-A-373-113-96	7.96	0.228	1651.30	0.169	27.118		2.10
AL-A-380-303-96	7.39	0.111	395.80	0.261	26.484	8.70	2.20
AL-A-392-316-95	7.36	0.185	423.47	0.753	17.115	8.30	2.00
AL-A-392-318-95	7.28	0.184	430.90	0.639	15.392	5.60	2.00
AL-A-413-308-96	7.78	0.840	1483.70	0.711	296.736	9.40	1.30
AL-A-419-106-95	7.01	0.497	227.61	0.328	17.715	6.80	3.00
AL-A-425-314-96	8.19	0.583	3922.10	1.036	49.254	8.10	1.40
AL-A-441-309-95	6.92	0.045	118.03	0.155	11.591	11.20	2.00
AL-A-465-311-96	7.43	0.112	560.90	0.256	17.632	8.60	1.50
AL-A-465-324-96	7.24	0.086	282.70	0.304	17.098	7.80	2.10
AL-A-480-205-96	7.10	0.071	232.50	0.455	12.980	8.90	1.20
AL-A-485-220-96	6.82	0.072	140.60	0.676	13.862	7.90	1.70

Table 7 (cont.). Water chemistry data collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Site	pH	Conductivity (µS/cm)	Acid Neutralizing Capacity (µeq/L)	Nitrate (mg/L)	Sulfate (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Organic Carbon (mg/L)
AL-A-485-227-96	7.50	0.137	446.60	0.738	23.503	7.20	2.10
AL-A-500-103-95	6.59	0.045	125.31	0.153	11.320	6.10	2.00
AL-A-524-211-95	7.20	0.172	240.62	0.225	16.776	7.60	2.00
AL-A-550-204-96	7.13	0.116	338.80	0.366	27.660	8.30	2.30
AL-A-553-306-95	7.45	0.078	449.64	0.248	14.211	9.20	2.00
AL-A-578-110-96	6.55	0.054	63.60	0.504	13.972		1.50
AL-A-585-122-96	8.08	0.467	3503.90	2.456	37.010	8.20	2.30
AL-A-598-602-96	6.73	0.416	378.30	0.523	100.251		1.50
AL-A-626-216-96	7.51	0.104	629.40	0.676	12.887	8.50	1.10
AL-A-635-113-95	6.95	0.058	131.40	0.114	15.278	4.80	2.00
AL-A-646-207-95	7.19	0.070	313.47	0.169	18.077	2.70	2.00
AL-A-688-319-95	7.12	0.046	181.48	0.316	10.085	7.70	5.00
AL-A-706-228-96	6.25	0.041	30.60	0.269	9.764	7.50	2.40
AL-A-709-303-95	6.98	0.051	165.54	0.292	10.535	8.40	2.00
AL-A-726-115-96	6.73	0.133	85.60	1.324	41.679	7.70	0.80
AL-A-729-119-95	6.35	0.041	55.87	0.141	12.371		4.00
AL-A-731-313-95	8.08	0.373	4286.44	1.626	26.357	9.00	
AL-A-999-117-96	8.09	0.366	2622.00	2.755	42.972	8.90	1.70

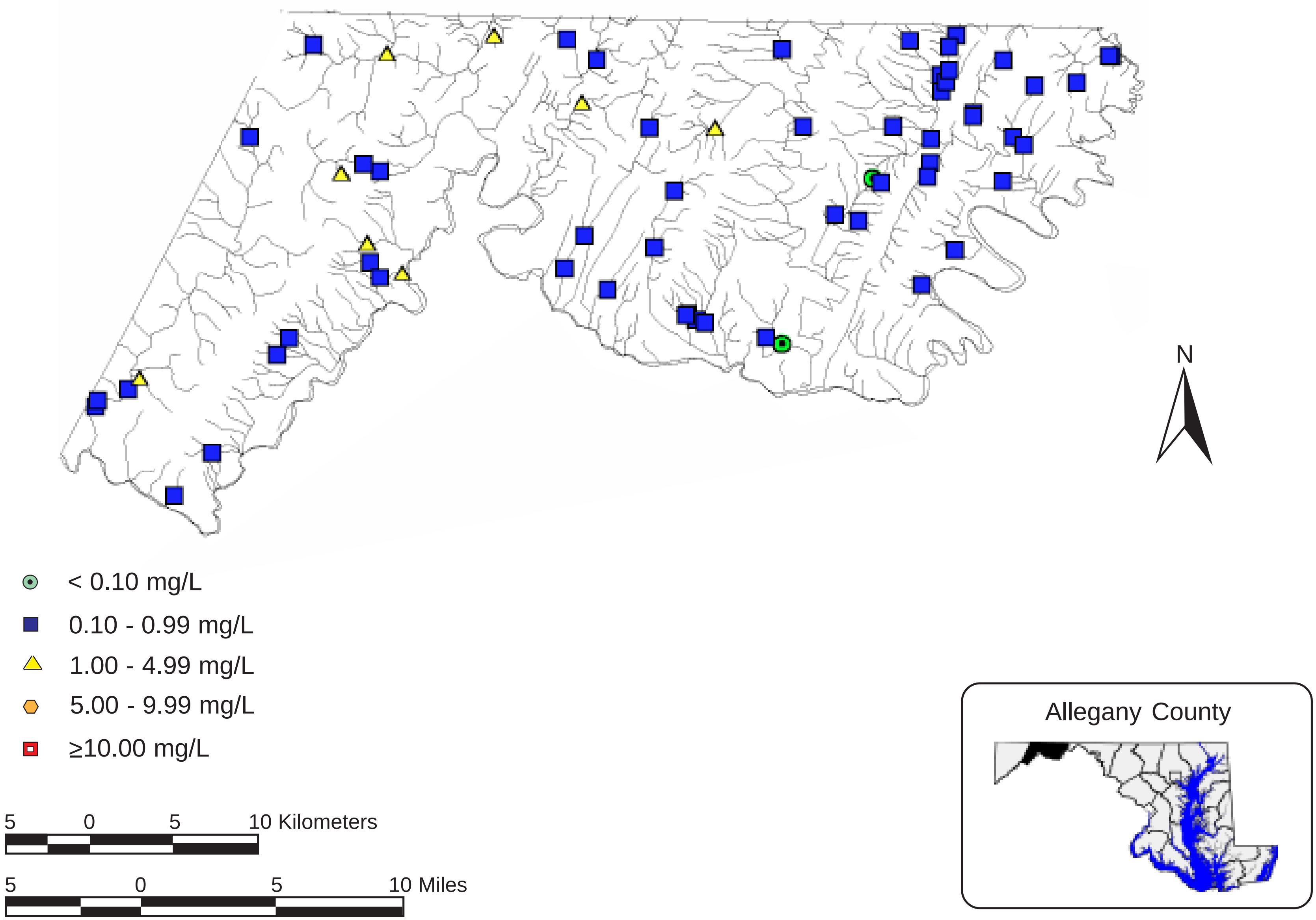

Figure 6. Nitrate-nitrogen concentrations (mg/L) at Maryland Biological Stream Survey sites in Allegany County, 1994-1997.

Literature Cited

Barbour, M.T., and J.B. Stribling. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. In: Biological Criteria: Research and Regulation. U.S. Environmental Protection Agency, Washington, D.C. EPA-440/5-91-005. pp. 25-38.

Cairns, J. and J.R. Pratt. 1993. A history of biological monitoring using benthic macroinvertebrates. In Rosenberg, D.M. and V.H. Resh, eds. Freshwater Monitoring and Benthic Macroinvertebrates. Chapman and Hall, New York

CBRM (Chesapeake Bay Research and Monitoring Division). 1989. Acid deposition in Maryland. Summary of results through 1988. Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. AD-89-1. NTIS No. PB89-182729/AS.

Chaillou, J.C. 1995. Technical Memorandum, The Maryland Biological Stream Survey: Summary of landowner contact procedures. Prepared by Versar, Inc., Columbia, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD. CBWP-MANTA-EA-95-1.

Cochran, W.G. 1977. Sampling Techniques. 3rd ed. New York: John Wiley and Sons.

EPA (U.S. Environmental Protection Agency). 1987. Handbook of methods for acid deposition studies: Laboratory analysis for surface water chemistry. EPA-600/4-87/026.

Hall, L.W., Jr., R.P. Morgan II, E.S. Perry, A. Waltz. 1999. Development of a provisional physical habitat index for Maryland freshwater streams. Prepared by Wye Research and Education Center, Queenstown, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment 455.

Heimbuch, D.G., J.C. Seibel, H.T. Wilson, P.F. Kazyak. 1999. A multiyear lattice sampling design for Maryland-wide fish abundance estimation. Journal of Agricultural, Biological, and Environmental Statistics. 4: 443-455.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist 20: 31-39.

Janicki, A., D. Wade, D. Heimbuch, H. Wilson, P. Jacobson, P. Kazyak. 1993. Maryland Biological Stream Survey design report. Prepared for Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division, by Coastal Environmental Services, Linthicum, MD. CBRM-AD-93-1.

Jessen, R.J. 1978. Statistical Survey Techniques. John Wiley, New York.

Karr. J.R. 1991. Biological integrity: A long-neglected aspect of water resource management. Ecological Applications 1: 66-84.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey Special Publication 5. 28 pp.

Kazyak, P.F. 1996. Maryland Biological Stream Survey Sampling Manual. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division.

Kazyak, P.F. 1994. Maryland Biological Stream Survey Sampling Manual. Prepared by Versar, Inc., Columbia, MD, for Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division.

Kerans, B.L. and J.R. Karr. 1994. A benthic index of biotic integrity (B-IBI) for rivers of the Tennessee valley. Ecological Applications 4: 768-785.

Knapp, C.M., W.P. Saunders, D.G. Heimbuch, H.S. Greening, and G.J. Filbin. 1988. Maryland

Synoptic Stream Chemistry Survey: Estimating the number and distribution of streams affected by or at risk from acidification. Prepared by International Science and Technology, Inc., Reston, VA, for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD. AD-88-2. NTIS No. PB88-213996/AS.

Knapp, C.M. and W.P. Saunders. 1987. Maryland Synoptic Stream Chemistry Survey design report. Prepared by International Science and Technology, Inc. for Maryland Department of Natural Resources, Power Plant Research Program. AD-87-5.

Lenat, D.R. 1988. Water quality assessment of streams using a qualitative collection method for benthic macroinvertebrates. Journal of North American Benthological Society 7: 222-223.

Miller, D.L., P.M. Leonard, R.M. Hughes, J.R. Karr, P.B. Moyle, L.H. Schrader, B.A. Thompson, R.A. Daniels, K.S. Fausch, G.A. Fitzhugh, J.R. Gammon, D.B. Halliwell, P.L. Angermeier, and D.J. Orth. 1988. Regional applications of an index of biotic integrity for use in water resource management. Fisheries 13(5): 12-20.

Ohio EPA (Ohio Environmental Protection Agency). 1987. Biological criteria for the protection of aquatic life. Volumes I-III. Ohio EPA, Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA 440-4-89-001.

Ranasinghe, J.A., S.B. Weisberg, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1994. Chesapeake Bay Benthic Community Restoration Goals. Prepared by Versar, Inc. for U.S. EPA and the Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division.

Rankin, E.T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, methods, and application. Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Analysis Section, Columbus, OH.

Resh, V. H., 1995. Freshwater benthic macroinvertebrates and rapid assessment procedures for water quality monitoring in the developing and newly industrialized countries. In: Davis, W.S. and T.P. Simon, eds. 1995. Biological assessment and criteria: tools for water resource planning and decision making. Lewis Publishers, Boca Raton, FL.

Roth, N.E., M.T. Southerland, G. Mercurio, J.C. Chaillou, P.F. Kazyak, S.A. Stranko, A.P. Prochaska, D.G. Heimbuch, and J.C. Seibel. 1999. State of the Streams: 1995-1997 Maryland Biological Stream Survey Results. Prepared by Versar, Inc., Columbia, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. CBWP-MANTA-EA-99-6.

Roth, N.E., M.T. Southerland, J.C. Chaillou, H.T. Wilson, D.G. Heimbuch, and J.C. Seibel. 1998a. Maryland Biological Stream Survey: Ecological Status of Non-tidal Streams Sampled in 1996. Prepared by Versar, Inc., Columbia, MD, and Post, Buckley, Schuh, and Jernigan, Inc., Bowie, MD, for Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. CBWP- MANTA-EA-98-1.

Roth, N.E., M.T. Southerland, J.C. Chaillou, R.J. Klauda, P.F. Kazyak, S.A. Stranko, S.B. Weisberg, L.W. Hall, Jr., and R.P. Morgan II. 1998b. Maryland Biological Stream Survey: Development of a Fish Index of Biotic Integrity. Environmental Management and Assessment 51: 89-106.

Roth, N.E., M.T. Southerland, J.C. Chaillou, J.H. Volstad, S.B. Weisberg, H.T. Wilson, D.G. Heimbuch, and J.C. Seibel. 1997. Maryland Biological Stream Survey: Ecological Status of Non-Tidal Streams in Six Basins Sampled in 1995. Prepared by Versar, Inc., Columbia, MD and Coastal Environmental Services, Linthicum, MD for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. CBWP-MANTA-EA-97-2.

Simon, T.P. ed. 1999. Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Washington DC.

Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. Transactions of the American Geophysical Union 38(6): 913-920.

Stribling, J.B., B.K. Jessup, J.S. White, D. Boward, M. Hurd. 1998. Development of a benthic index of biotic integrity for Maryland streams. Prepared by Tetra Tech, Inc., Owings Mills, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD. CBWP-EA-98-3.

Tornatore, T., P. Jacobson, J. Gerritsen and A. Janicki. 1992. Data sets for developing measures of biological integrity in Maryland streams. Prepared by Versar, Inc., Columbia, MD, for the Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. AD-93-7.

Weisberg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz, J.B. Frithsen. 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. Estuaries 20: 149-158.

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Appendix A. Summary of the types of data collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Abbreviations used are as follows: F-IBI - Fish Index of Biotic Integrity; B-IBI Benthic Macroinvertebrate Index of Biotic Integrity; Fam.IBI - Family-Level Benthic Macroinvertebrate Index of Biotic Integrity; PHI - Physical Habitat Index.

Site	Stream Name	Fish	Benthic Macroinvertebrate	Herpetofauna	Habitat	Water Chemistry	F-IBI	B-IBI	Fam. IBI	PHI
AL-A-007-304-96	North Br Of Jennings Run	X	X	X	X	X	X	X		X
AL-A-020-228-95	Maple Run	X	X	X	X	X	X	X		X
AL-A-027-205-95	Terrapin Run	X	X	X	X	X	X	X		X
AL-A-027-209-95	Terrapin Run	X	X	X	X	X	X	X		X
AL-A-033-314-95	Fifteenmile Creek	X	X	X	X	X	X	X		
AL-A-054-320-96	Georges Cr	X	X	X	X	X	X	X		X
AL-A-061-125-95	Ut Deep Run		X			X		X		
AL-A-069-102-95	White Sulphur Run		X			X		X		
AL-A-143-226-95	Ut Fifteenmile Creek	X	X	X	X	X	X	X		X
AL-A-146-301-95	Fifteenmile Creek	X	X	X	X	X	X	X		X
AL-A-148-201-96	Seven Springs Run		X			X		X		
AL-A-167-230-95	Ut Fifteenmile Creek	X	X	X	X	X	X	X		X
AL-A-171-206-95	Ut Fifteenmile Creek	X	X	X	X	X	X	X		X
AL-A-177-232-95	Deep Run	X	X	X	X	X	X	X		X
AL-A-187-218-96	Un Trib To Potomac R	X	X	X	X	X	X	X		X
AL-A-199-122-95	Ut Terrapin Run	X	X	X	X	X		X		X
AL-A-202-121-96	Warrior Run	X	X	X	X	X	X	X		X
AL-A-207-307-95	Fifteenmile Creek	X	X	X	X	X	X	X		
AL-A-215-112-95	Ut Maple Run	X	X	X	X	X		X		X
AL-A-221-107-96	Un Trib To Georges Cr	X	X	X	X	X	X	X		X
AL-A-232-313-96	Sand Spring Run	X	X	X	X	X	X	X		X
AL-A-233-601-96	Elk Lick Run	X	X	X	X	X		X		
AL-A-244-227-95	Flat Run	X	X	X	X	X	X	X		X
AL-A-248-213-95	Sawpit Run	X	X	X	X	X	X	X		X
AL-A-248-234-95	Sawpit Run	X	X	X	X	X	X	X		X
AL-A-254-326-96	Braddock Run	X	X	X	X	X	X	X		X
AL-A-255-108-95	Ut Potomac R	X	X	X	X	X		X		X
AL-A-268-221-96	Seven Springs Run	X	X	X	X	X	X	X		X
AL-A-276-323-96	Evitts Cr	X	X	X	X	X	X	X		X
AL-A-281-104-96	Dry Run		X			X		X		
AL-A-294-325-96	Trading Run	X	X	X	X	X	X	X		X
AL-A-296-226-96	Un Trib To Jennings Run	X	X	X	X	X	X	X		X
AL-A-318-126-95	Ut Sidling Hill Creek	X	X	X	X	X	X	X		X
AL-A-319-219-96	Pea Vine Run		X			X		X		
AL-A-343-307-96	Georges Cr	X	X	X	X	X	X	X		X

Appendix A (cont.). Summary of the types of data collected at Maryland Biological Stream Survey sites in Allegany County, 1994-1997. Abbreviations used are as follows: F-IBI - Fish Index of Biotic Integrity; B-IBI - Benthic Macroinvertebrate Index of Biotic Integrity; Fam. IBI - Family-Level Benthic Macroinvertebrate Index of Biotic Integrity; PHI - Physical Habitat Index.

Site	Stream Name	Fish	Benthic Macroinvertebrate	Herpetofauna	Habitat	Water Chemistry	F-IBI	B-IBI	Fam. IBI	PHI
AL-A-343-330-96	Georges Cr	X	X	X	X	X	X	X		X
AL-A-373-113-96	Un Trib To Seven Springs Run		X			X		X		
AL-A-380-303-96	Mill Run	X	X	X	X	X	X	X		X
AL-A-392-316-95	Ut Sidling Hill Creek	X	X	X	X	X	X	X		X
AL-A-392-318-95	Ut Sidling Hill Creek	X	X	X	X	X	X	X		X
AL-A-413-308-96	Braddock Run	X	X	X	X	X	X	X		X
AL-A-419-106-95	Ut Fifteenmile Creek	X	X	X	X	X		X		X
AL-A-425-314-96	Elk Lick Run	X	X	X	X	X	X	X		X
AL-A-441-309-95	White Sulphur Run	X	X	X	X	X	X	X		
AL-A-465-311-96	Collier Run	X	X	X	X	X	X	X		X
AL-A-465-324-96	Collier Run	X	X	X	X	X	X	X		X
AL-A-480-205-96	Mill Run	X	X	X	X	X	X	X		X
AL-A-485-220-96	Un Trib To Potomac R	X	X	X	X	X	X	X		X
AL-A-485-227-96	Un Trib To Potomac R	X	X	X	X	X	X	X		X
AL-A-500-103-95	Ut White Sulphur Run	X	X	X	X	X		X		X
AL-A-524-211-95	Ut Fifteenmile Creek	X	X	X	X	X	X	X		
AL-A-550-204-96	Un Trib To Brice Hollow Run	X	X	X	X	X	X	X		X
AL-A-553-306-95	Flintstone Creek	X	X	X	X	X	X	X		X
AL-A-578-110-96	Un Trib To Mill Run		X			X		X		
AL-A-585-122-96	Un Trib To Potomac R	X	X	X	X	X	X	X		X
AL-A-598-602-96	Georges Cr		X			X		X		
AL-A-626-216-96	Mill Run	X	X	X	X	X	X	X		X
AL-A-635-113-95	Ut Town Creek	X	X	X	X	X		X		X
AL-A-646-207-95	Ut Potomac R	X	X	X	X	X	X	X		X
AL-A-688-319-95	Fifteenmile Creek	X	X	X	X	X	X	X		
AL-A-706-228-96	Collier Run	X	X	X	X	X	X	X		X
AL-A-709-303-95	Fifteenmile Creek	X	X	X	X	X	X	X		
AL-A-726-115-96	Un Trib To Braddock Run	X	X	X	X	X		X		X
AL-A-729-119-95	Ut Piclic Run		X			X		X		
AL-A-731-313-95	Murley Branch	X	X	X	X	X	X	X		X
AL-A-999-117-96	Un Trib To Wills Cr	X	X	X	X	X	X	X		X

Appendix B. Physical habitat condition measured by the Maryland Biological Stream Survey, 1994-1997. All variables rated on a scale of 0 (poor) to 20 (optimal) unless otherwise noted.

SUBSTRATE AND INSTREAM COVER

Instream Habitat is rated according to the perceived value of habitat to the fish community. Higher scores are assigned to sites with a variety of habitat types and particle sizes. In addition, higher scores are assigned to sites with a high degree of uneven substrate, including logs and rootwads. In streams where substrate types are favorable but flows are so low that fish are essentially precluded from using the habitat, low scores are assigned. If none of the habitat within a segment is useable by fish, a score of zero is assigned.

Epifaunal Substrate is rated based on the amount and variety of hard, stable substrates usable by benthic macroinvertebrates. Because they inhibit colonization, flocculent materials or fine sediments surrounding otherwise good substrates are assigned low scores. Scores are also reduced when substrates are less stable.

Velocity/Depth Diversity is rated based on the variety of velocity/depth regimes present at a site (slow-shallow, slow-deep, fast-shallow, and fast-deep). As with embeddedness, this metric varies by stream gradient.

Pool/Glide/Eddy Quality is rated based on the variety and spatial complexity of slow or still water habitat within the sample segment. In high-gradient streams, functionally important slow water habitat may exist in the form of larger eddies. Within a category, higher scores are assigned to segments which have undercut banks, woody debris or other types of cover for fish.

Riffle/Run Quality is based on the depth, complexity, and functional importance of riffle/run habitat in the segment, with highest scores assigned to segments dominated by deeper riffle/run areas, stable substrates, and a variety of current velocities.

Embeddedness is a percentage of surface area of larger particles that is surrounded by fine sediments on the stream bottom. In low gradient streams, embeddedness may be high even in relatively unimpaired watersheds.

CHANNEL CHARACTER

Channel Alteration is a measure of large-scale changes in the shape of the stream channel. Channel alteration includes: concrete channels, artificial embankments, obvious straightening of the natural channel, rip-rap, or other structures, as well as recent bar development. Ratings for this metric are based on the presence of artificial structures as well as the existence, extent, and coarseness of point bars, side bars, and mid-channel bars which indicate the degree of flow fluctuations and substrate stability. Evidence of channelization may sometimes be seen in the form of berms that parallel the stream channel.

Bank Stability is rated based on the presence/absence of riparian vegetation and other stabilizing bank materials such as boulders and rootwads, and frequency/size of erosional areas. Sites with steep slopes are not penalized if banks are composed solely of stable materials.

Channel Flow Status is the percentage of the stream channel that has water, with subtractions made for exposed substrates and dewatered areas.

RIPARIAN CORRIDOR

Shading is rated based on estimates of the degree and duration of shading at a site during summer, including any effects of shading caused by land forms.

Appendix B (cont.). Physical habitat condition measured by the Maryland Biological Stream Survey, 1994-1997. All variables rated on a scale of 0 (poor) to 20 (optimal) unless otherwise noted.

Riparian Buffer is rated according to the size and type of the vegetated riparian buffer zone at the site. Cultivated fields for agriculture that have bare soil to any extent are not considered as riparian buffers. At sites where the buffer width is variable, or direct delivery of storm runoff or sediment to the stream is evident or highly likely, the narrowest representative buffer width in the segment (e.g., 0 if parking lot runoff enters directly to the stream) is measured and recorded even though some of the stream segment may have a well developed riparian buffer.

AESTHETICS/REMOTENESS

Aesthetics are rated according to the visual appeal of the site and presence/absence of human refuse, with highest scores assigned to stream segments with no human refuse and visually outstanding character.

Remoteness is rated based on the absence of detectable human activity and difficulty in accessing the segment.